THE

FRANKLIN JOURNAL,

AND

AMERICAN MECHANICS' MAGAZINE;

DEVOTED TO THE

USEFUL ARTS, INTERNAL IMPROVEMENTS, GENERAL SCIENCE,

AND THE RECORDING OF

AMERICAN AND OTHER PATENTED INVENTIONS.

NOVEMBER, 1828.

An Essay on Calico Printing.

[Extracted from Parke's Chemical Essays.]

[CONTINUED FROM PAGE 228.]

In reverting to the remaining processes of the print-work, it must be noticed, that when the goods have passed through the weld or madder copper, they are usually carried to a boiler containing wheat-bran and water, in which they are winched for a considerable time, for the purpose of freeing the white grounds from the stain which they had acquired from the madder or the weld. This process always impairs, in some measure, the intensity of the colours; but it is a necessary operation, as there is no other mode so convenient for removing the stain which is always given to the white part of the print by the madder, the bark, or the weld, which has been used in dying it.

Branning has also the effect of giving a pink hue to all madder reds. But it is not generally known what a peculiar richness may be imparted to madder colours, by raising them with a mixture of bran and madder; that is, by mixing a portion of bran with the madder in the first instance. I have myself sometimes produced colours in this way, whose brilliancy has astonished me.

This mode of dying red with a mixture of bran and madder, is called, in the trade, *Growse's*, or London pink, and was invented by a journeyman calico-printer, near London, of the name of Growse, who sold the recipe for 100 guineas. In this process, the acid of the bran prevents the precipitation of the *fawn-coloured* particles of the madder, and the red produced is, consequently, more rosy and pure.

engines, whereby the force is augmented, and the expense diminished—10 years.

To Joanne Brothers: Mouzin, Philibert; and Lecomte, Eugene, Dijon, for a machine for causing boats to sail up a current by the impulse of the water only, and which may be applied to land carriages by means of using steam—15 years.

To Muller, Charles Francois, Paris, painter, for a mechanical desk—5 years.

To Willer, Jean Charles Guillaume, surgeon, Paris, for a lotion, called *Eau d'Hebe*, for removing freckles—5 years.

To Poisson, Louis Pierre, Paris, for a process of making paper and pasteboard, of liquorice root—5 years.

To Garat, Joseph Dominique Febry, Paris, for an extra clog or shoe, called a *paracrotte*, for guarding the feet and legs from damp and dirt—5 years.

To Caire, Jean Alexis, Paris, for a machine with a swivel, for corking bottles—10 years.

To Marquis de Saint Croix Molay, Pierre Hyppolite de la Poterre, Paris, for the invention of moveable metallic arches, or metallic portable siloes—15 years.

To Messrs. Brian and De St. Leger, Paris, for a process for making hydraulic artificial lime—15 years.

To Dalton, Samuel, Paris, for a method of making silk, cloth, and other buttons, without seams, by machinery—5 years.

To Causon, Brothers, paper makers, of Armonay, for a method of sizing paper—15 years.

To Beaudouin, Jean Baptiste, Paris, for a sub-marine navigation—15 years.

To Houzeau, Nicolas, Paris, for a method of lighting by portable gas—5 years.

To Harmey, Joseph, Paris, for a method of using carding machines by hydrostatics—5 years.

To Lavand, Antoine, writing master, Perigueux, Dordogne, for a method of teaching four kinds of writing in twenty lessons, and ten in sixty lessons. This valuable system is called the *Calligraphie Francoise*—5 years.

To Durant, Nicholas Felix, Chalons-sur-Marne, for a new invented coffee pot—5 years.

To Tregnet, Vincent Pluvoise, piano-forte maker, Paris, for a piano with isolated sounding board—10 years.

To Joannis, secretary to the board of health, Paris, for a method of purifying metals, minerals, cast iron, and metals in general, used in casting—15 years.

To Proust, Alexis, Rochelle, Charente, for a distillery and apparatus—5 years.

To Revillon, Thomas, clock and watchmaker, Macon, Soane and Loire, for sundry improvements in striking the hours of public and private clocks—10 years.

Erratum.—In p. 202, (last number) line 15 from the top; for *or sound*, read *on sound*.

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Madder contains two distinct species of colouring particles, a beautiful red or rose colour, and a degraded yellow or fawn colour —both are precipitated on the cloth, in the usual dying process, to the great injury of the *tint* obtained. The object of the tedious Turkey-red process, is to fix the red colouring particles so firmly as to allow the fawn-coloured ones to be dissolved and discharged by long boiling in solution of soap or soda, by oxymuriate of soda, or by acid solutions of tin. A dilute supersulphate of potash has lately been used with success for this purpose, in France.*

It frequently is the case, however, that goods will not bear to be sufficiently branned to clear the whites entirely by that one operation;† such goods, therefore, are partially cleansed in the branning-copper, and are then laid on the grass for some days, until they become perfectly clean and white.

But, within the last few years, a new method has been introduced, which consists in immersing the pieces for a certain time in a very weak solution of one of the bleaching salts, such as oxymuriate of potash, soda, or magnesia. This simple process, which effects, in a few minutes, what would require more than as many days in grass-bleaching, is now much practised, and promises, very soon, to supersede crofting entirely. This is a most important improvement, as some of the large printers formerly required as much land to spread out their goods upon, as would make a farm of a very considerable size.

Besides the kinds of calico-printing already mentioned, there are others which it will be proper to notice in this place. Of these, what is called resist-work, is now done in considerable quantities. It is conducted in the following manner.

A certain preparation of copper, mixed either with flour paste, with gum, or with pipe-clay and gum, is printed on the calico, in any shape or of any pattern that may be desired.‡ When this is sufficiently dry, the goods are repeatedly dipped in the blue vat till they have acquired that depth of tint which may be required. The art of making an indigo-vat, or blue-vat, as it is sometimes called, consists in forming such a mixture of lime and sulphate of iron as shall most effectually deoxidize the indigo; as indigo has no affinity for cloth in its natural or oxygenized state. Hence those parts of a piece which are printed with the solution of copper, will never be dyed blue in one of these vats; because the deoxidized indigo becomes oxygenated the moment it touches the copper, which parts

* See "A Collection of Observations on Madder," by Berthollet, *Annales de Chimie*, tom iv. page 102. M. Watt "On the Properties of Zealand Madder." *Ibid.* page 104. Vogler "On dying Cotton with Madder." *Ibid.* page 109.

† The temperature at which the operation of branning is performed, is very important. If bark yellows are dyed at 100°, it is customary to bran such goods at 115° or 120°, as it is a principle always to bran at a higher temperature than the goods are dyed at. Madder-work must be branned at a boiling heat.

‡ The sulphate, the nitrate, the muriate, and the acetate of copper, have all been employed for preparing the resist-paste; but I believe the sulphate is the best for the purpose, unless a very concentrated solution of the four salts were prepared by successively dissolving each of them in pure water.

with its oxygen to the indigo, and occasions it to become insoluble, and, consequently, incapable of forming a dye.

Thus, while sulphate of iron has the power of deoxidizing indigo, sulphate of copper, or any other salt of that metal, is incapable of retaining its oxygen, whenever it comes in contact with that singular substance in a state of deoxidizement; and it is a curious instance of the different degree of intensity by which oxygen is held by the different metals.

I suspect, however, there is often great waste in the management of these vats, and that the contents are often thrown away long before the indigo is spent, in consequence of the want of a due admixture of the lime and the sulphate of iron with the colouring matter; whereas, if a dyer or calico-printer be acquainted with chemical science, he will understand the nature of the operation of these substances upon each other, and hence can be at no loss how to keep up the vat to its original strength, by replenishing it, occasionally, with one or other of the ingredients, as may be required.

The fact is, that indigo, unless it be deoxidized, is insoluble either in the alkalies or the alkaline earths; but when this is effected by the iron of the copperas, the lime dissolves it, and forms it into a perfect solution of indigo. At first, a portion of the lime abstracts the sulphuric acid from the copperas, and precipitates with it in the state of sulphate of lime. The detached metal being now in the state of the protoxide of iron, and having in that stage of its oxidizement a great affinity for oxygen, it takes it from the indigo, and thus becomes changed to the peroxide of iron, which, being insoluble, precipitates likewise. Thus the acid, and the base of the sulphate of iron, are, at length, both precipitated, when the remaining portion of lime seizes the deoxidized indigo, and forms with it the solution desired. When the principle of the blue-vat is thus properly understood, it is an easy thing for the manager, at any time, to discover which of the three materials is deficient, and to add it accordingly. I am the more desirous of offering these remarks, because I have many times heard the proprietors of a manufactory declare, that they have, occasionally, thrown away the whole contents of a new vat, containing many pounds worth of indigo, because the foreman or managers of the works had not observed the due proportions of the lime and the copperas, to put the indigo into a proper state for working; and they have an idea, if it is once wrong, it must be always so, and, therefore, they throw it away, without attempting to correct the error.

To revert to the process of resist-work, it is necessary to say, that when the pieces have been sufficiently immersed in the blue-vat, and have been washed and passed through diluted sulphuric acid, those parts which had been printed with the preparation of copper, are found to be preserved a good white; the preparation having effectually resisted the operation of the indigo, though all the other parts of the cloth have received a permanent dye. The various deep blue calicoes with white spots or white figures, which are now so common, are, generally, done in this way; and, by a similar management with

subsequent dying in madder, in weld, or quercitron bark, figures in red or yellow (as the case may be) are exhibited upon a blue ground.

In some particular styles of work, the operation of certain colours is resisted by means of stopping out with wax; but this is too expensive a method to be adopted often, in these times, when it is the object of every manufacturer to finish his prints at the least possible expense. Formerly, this mode was very generally practised, and wax was consumed in very large quantities by this process.*

In printing those silk handkerchiefs, called Bandanas, a process called waxing is still followed. It consists in making a preparation of tallow and rosin, very liquid by heat, and in printing it in that state, with a block, upon the silk. When such goods are passed through the blue-vat, those parts which are covered with the tallow and rosin, are preserved from the action of the indigo, and remain white, while all the rest is dyed a fast blue. The method afterwards taken to discharge a part of this blue, and produce yellow, orange, &c. will be mentioned hereafter.

A very singular looking substance was discovered a few years ago near Stockport, which, being handed about from one to another, created considerable interest in that neighbourhood. Every body supposing it to be a natural production, specimens of it were sent to a variety of persons in various parts of the kingdom, for their opinion and analysis, and among others a portion was sent to myself. However, after every one had been busily engaged in examination and conjecture, respecting this unknown substance, it was announced, that some seventy or eighty years before, a calico-work had stood on the spot where the article was found, and that this was nothing more than a large heap of the refuse compound of flour, wax, and gum, above-mentioned.

The reader will perceive that these *resists* are employed for the purpose of preserving certain parts of a piece white, and of giving other varieties to those goods in which blue is the predominant colour; but if the ground is to be white, and the piece is only to have one small object† in indigo blue, such as a single sprig, then a different management is necessary, and the colour is imparted by a process which is called *pencil-blue*.

Here the indigo is deoxidized by means of orpiment, which is a sulphuret of arsenic; and, formerly, whatever objects were done with it were put in by means of a pencil: hence its name, PENCIL-BLUE.

Pencil-blue is composed of the following ingredients, viz. Ten ounces of indigo finely ground in water; twenty ounces of quicklime in lumps; the same quantity of potash of commerce, or the impure sub-carbonate of this alkali; and ten ounces of orpiment. These proportions require one gallon of water, and when the whole has been properly mixed, and time has been allowed for the sediment to subside, the clear colour is to be carefully poured off and thickened with gum senegal.

* In the East Indies, wax is still used for preserving the whites in calico-printing.

† *Object* is a technical term belonging to this branch of manufacture.

The intention in using this preparation, had always been to impart it to the calico, before the indigo had time to recover its oxygen: hence, a small quantity only was mixed at once, or no more than could be pencilled on in a very short time; but the inconvenience which attended this plan, gave rise, at length, to an invention which has nearly superseded the use of the pencil.

The invention to which I refer, is the spring-sieve, which may be thus described: A fine canvass sieve is suspended within a tub of pencil-blue colour, so contrived, that the canvass should be in contact with the colour, and follow it as it is wasted. But as the colour was consumed, the sieve did not always exactly sink with it, which occasioned great uncertainty, and, sometimes, considerable disappointment, from the admission of too much atmospheric air:—to obviate these inconveniences, many schemes were resorted to, but none of them completely answered the purpose.

This utensil has, however, now been much improved by a particular friend of mine. The improvement consists, essentially, in the addition of a vessel upon the principle of the common bird fountain, which is filled with the prepared indigo, and closely corked. This supplies the blue-tub just as fast as it is exhausted.

Another kind of process remains to be noticed, called CHEMICAL-DISCHARGE work. Here the cloth is first dyed of some uniform colour, by means of a mixture of iron-liquor, and some one or more of the common vegetable dying substances; and calicoes thus prepared are said to be dyed of self-colours. They are then washed and dried; and when properly pressed or calendered, they are fit for receiving any pattern whatever, according to the taste or design of the artist.

This is generally effected by means of the mineral acids, which are previously prepared for the purpose, by dissolving in them a portion of one or more of the metals, according to the nature of the dye which is intended to be discharged, or of the colour to be produced. In doing this, care is taken that the discharging liquor be made so as to be capable of dissolving the iron which is contained in the dye, and which is always used in such quantity as to cover, or at least to disguise, in a great measure, the other colour or colours, which had been employed with it, and, at the same time, to act as a mordant, in beautifying and fixing those colours.

Thus a piece treated with a decoction of Brazil-wood, and dyed black by being padded* with iron-liquor, if, when dried, it be printed with a peculiar solution of tin, the ferruginous portion of the dye will be dissolved, and the printed part will instantly be converted from a deep black to a brilliant crimson.

In the same way, an olive-coloured calico, dyed in a solution of iron and a decoction of weld, will as quickly be changed to a pale bright yellow; and the various drabs and slates of every shade which

* By the term *padding*, is understood, the operation of passing the pieces from a roller through a trough containing a solution of iron, or any other mordant. *Blotching* is another term used in calico-printing, and is synonymous with padding.

have iron in their composition, will undergo as sudden a change, by the same treatment; though the colour of the figures produced on them will depend on the materials with which the cloths were originally dyed. Even the deepest gold colours, or strongest buffs, if produced by iron only, may, by a peculiar preparation of tin, be discharged; and such parts of the cloth as have been treated with this metallic solution, will be restored to their pristine whiteness.

By similar management, calicoes dyed of a light blue in the indigo-vat, then run through sumach and copperas, and finished in a bath of quercitron bark and alum, may have figures of a bright green imparted to them. Here the green is originally formed by means of the indigo-vat and the bark, though it is enveloped by the iron of the copperas, which overcomes the other colours, till the solution of tin is applied, which removes the iron from those particular parts, and gives a brilliancy to the remaining colours which they would not otherwise have possessed; the tin being a powerful mordant for the bark, by which the yellow of the green is produced.

Again, a good self-colour may be given to calicoes, merely by dying them in sumach and copperas, and then running them through an alkaline solution of annotto; and here the figures produced by the application of a colourless solution of tin, will be of a bright orange. But, it is needless to enumerate more instances, as the workman accustomed to a dye-house, will have little difficulty in varying these in a thousand ways, when he becomes acquainted with the nature of the solution of tin which he employs.

The whole of this, however, refers to that branch of discharge-work, only, where all the purposes are attained by dissolving the iron which makes a part of the colour that is intended to be discharged; whereas, the finer and more expensive work, is done in a different way, and by a process which it will be necessary for me, presently, to describe.

It is, however, proper to remark, that there is an objection to the particular kind of chemical discharge-work, of which I have been speaking, namely, that it is not perfectly fast; that is, the goods produced in this way, will not bear such frequent washing, as those which are done by the bath of madder or bark.

It is certainly an object of great national importance, to give a permanency and beauty to the calico-printing of the country;* and a great deal of very excellent printing is now done in various parts of the kingdom, especially for the best chintz-work and other furniture patterns. But, in what is called fast-work, there is a great variety of qualities, and some of it little deserves the name of permanent.

The mention of permanent colours, reminds me of a very valuable GREEN, which was invented some years ago, by a Mr. Islet of

* To this end, great improvements have, of late years, been made in the method of grinding madder-roots, by separating the inferior parts, and dividing the whole into two or three different qualities. Thus the printer is enabled to apply the finest, which, in this way, is made equal to Dutch crop-madder, to his best work, and the other can be laid by for inferior purposes.

London, and which deserves to be noticed in this essay. This colour, which was secured to him by his majesty's letters patent, is produced by printing ground indigo mixed with a peculiar kind of solution of tin, and in then fastening the indigo within the fibres of the calico, by means of that process, which is well known to printers by the technical designation of *china-blue dipping*.* After this, the goods are dyed in a copper of bark or weld, which converts the blue to a green, and the whites are afterwards cleansed by croft-bleaching, &c.

Having myself formed a very high opinion of this invention, I had several interviews with Mr. Islet, soon after he obtained the patent, and from him was fully informed of the whole process. This I have since repeated, for the purpose of verifying the detail in all its branches; and I am satisfied, that it is one of the most beautiful and PERMANENT colours that has ever been fixed upon cotton.

There is another mode of producing very beautiful blues, which has been much practised lately, and, therefore, deserves notice. This consists in printing some solution of iron, and then passing the goods through a very dilute and neutral solution of prussiate of potash. The Prussian blue which is thus formed upon the cloth, may be rendered tolerably permanent by a variety of expedients, and this, by means of any of the yellow dyes, may, afterwards, be formed to any shade of green or of olive.

[TO BE CONTINUED.]

Sketches of the Progress of Inventions, connected with Navigable Canals. Compiled from various sources.

[FROM THE BOSTON JOURNAL OF SCIENCE.]

[Continued from p. 233.]

THE following is a description of a new mode of building locks, invented by J. L. Sullivan, Esq., which he denominates the *Composite Lock*. Communicated by the inventor.

The object of the Composite Lock is, to use wood, as the cheapest material, and yet so that it shall be *durable*. This is effected by excluding from the substance of the structure, the *causes* of decay, *air* and *water*. The means of doing it, are found in the following mechanical and chemical principles, using as materials, thin boards, sheathing-paper, pitch, and lime.

The manner of building, affords the greatest strength, because the fibres of the wood cross each other in alternate layers, transverse and lengthwise; trenailed very firmly, as they are successively put together; and with intermediate tarred paper; each succeeding sur-

* China-blue is produced thus:—Indigo, ground fine, and then thickened, is printed upon the cloth, and afterwards it is dissolved, and chemically united to the fabric, by alternate immersion in a solution of sulphate of iron and in lime-water.

face being payed with pitch, after the seams are caulked. This separation of every piece of wood, from every other, prevents fermentation and rot between them; and, if the work is well done, the structure must be impervious to water and air. Then, as carbonaceous substances are of an imperishable nature, this wooden fabric, by being penetrated and filled with tar, must, by its efficacy, remain sound, as long as this substance retains that property.

The use of a small proportion of lime, among the pitch, is to form a *cement*, and neutralize any acid that may be in the wood.

This method has some analogy to the well known use of the pyroligneous acid, in preserving provisions, now beginning to be applied to the timber in ships. Its efficacy is attributable to the antiseptic properties of the components of smoke (vinegar and carbon.) Smoke differs from tar, principally, in being *volatile*, instead of being concentrated. But pitch, which is a more concentrated tar, is better for this purpose; because, besides penetrating the pores of the wood, it forms a defence of its surface. One of the late improvements in the British navy, (by Mr. Seppings) among others, is to inject a ship's frame, or to fill the pores of the wood with tar.

The manner of building a *composite lock chamber*, is simply this: the pit being dug, rough walls will, of course, be necessary to sustain the ground: these will also sustain the lock laterally, and its upper end.

After bolting a cap-piece on the walls, having an under groove overhanging the space a few inches, and after flooring the space between the walls with a mass of small stones for the bottom of the chamber to rest on, the work is begun by lining the space, first with thin oak boards, (as bending more easily) which reach from the under groove of the cap on one side, down the wall, across the bottom, and up the opposite wall to the groove on the other side, nailed to each cap. The seams being caulked with oakum, and the whole surface payed, it is then covered with tarred paper. It is now ready to receive the first *lengthwise* layer of pine, to be trenailed or nailed through the paper to the first layer. This second course is next to be caulked, and payed, and papered, to receive the *second transverse* layer of oak, which is covered and completed in like manner; and the fourth course, or second lengthwise (if the last) is finished by caulking and graving. The *trenails* of the successive lamina all reach to the first layer. They are made by machinery, and compressed, that they may expand and cohere more firmly after being driven.

But if the lock is of uncommon depth, which this method of building permits, one or two courses more may be expedient. Two locks of this kind may be made to lift as many feet perpendicularly, as *three* locks on the old and usual plan: thus saving one-third of the locks of a canal.

The outside surface only, is exposed to the air; but as it is in contact with stone, which keeps it cool, it will remain sound. The inside surface will be protected sufficiently, by a renewal of its coat of pitch from time to time. The bottom, being always under water, will remain sound. The gate-posts may be either of wood, stone, or

cast iron. Instead of culverts, horizontal pivot gates are used (as on Middlesex canal;) placed above the upper pair of lock gates, which let the filling water descend into the lock chamber, through the upper floor; the lower floor being protected from wearing, by means of timbers, plank, or stone.

The saving, in the first cost of this kind of lock, compared with cemented walls, is such, that were the difference put at *interest* for the period of its duration, it would amount to many times more than the expense of replacing the chamber, eventually. It is, therefore, true economy. This manner of building, is also well adapted to our country and climate; as the material abounds, and the frost sometimes heaves the walls of locks, and destroys the cohesion of their cement: in England and France, the winters are too mild for this effect.

Thus great durability is given to a wooden structure, and lockage in river works made more practicable, and less costly. In this way may be also constructed the *aqueducts* of a canal.

J. L. Sullivan.

Mr. Sullivan has also furnished a description of a machine, invented by Mr. Dearborn, of this city, as a substitute for the lock. This machine, although it bears a strong resemblance to some of the inventions described in our last, under the name of balance locks, is yet, we should think, more practicable than any of them. A single vessel, which Mr. Dearborn calls a *transit*, is suspended by chains, running over pullies, and counterbalanced by weights. In this, the canal boat is moved vertically, from one level to the other, and such provisions are made, that no change of the levels, from floods or drought, can derange the operations.

Having noticed the principal inventions for uniting different levels or sections of canals, we shall proceed with an account of some of the striking improvements in the architecture of these works. Amongst these, none are more imposing than the tunnels and aqueducts. The first tunnel constructed for the purpose of navigation, was on the Languedoc canal. This was considered the wonder of its time. It was cut through the ridge of Malpas, near the town of Beziers; its length is 720 feet, and, for the most part of the way, it is lined with stone. The expense of this work has been stated at 13,000,000 livres. An enormous sum, considering the value of money, and the resources of France at that period (1670).

The tunnels connected with Bridgewater's canal, were the first works of the kind undertaken in England, and they continue unrivalled in extent and importance. These tunnels are said to be, in all, more than 18 miles in length; many of them hewn out of the solid rock, and sufficiently large for the passage of boats 4½ feet wide. From a branch which passes under Manchester, coals are taken up, for the supply of that town, by simple machinery, constructed by Brindley.*

* James Brindley, the engineer under whose direction Bridgewater canal was constructed, and whose name is so intimately connected with canal improve-

Tunnelling can only be accomplished by tedious digging and blasting; it necessarily goes on slowly, as no more room can be obtained for the labourers, than they burrow for themselves.

Aqueducts for continuing canals over vallies and rivers, are constructed on principles similar to those which guide the construction of bridges. They differ little from the common bridge, except in having, in the place of a road, a water-tight channel, through which the canal water and boats pass. Aqueducts, equally with bridges, may be made an ornament to the country, by a proper architectural arrangement. It is not our purpose, however, to consider them in the light of ornamental structures, but simply as works for continuing the levels of canals. In this view, the material of which they are constructed is of great importance. In Europe, until within a few years, stone was the only substance considered proper for these works; and the ancient aqueducts, for supplying cities with water, attest forcibly to the durability of this material. Wood, which has been so freely used in all works in this country, has, up to the present time, been the principal article in our aqueducts. But its certain and speedy decay, has shown how utterly unfit it is for

ments, possessed so rare a genius, and was of so singular a character, that we cannot forbear giving some account of him. He was born in Derbyshire, in 1716, and his father, having wasted his small property in field sports, young Brindley was obliged to labour, almost from his infancy. At the age of seventeen, he bound himself apprentice to Mr. Bennett, a millwright, near Macclesfield. Here, the superiority of his genius unfolded itself, and long before the expiration of his apprenticeship, the millers placed more confidence in his opinions than in those of his master, and such was his devotion to his business, that for the purpose of obtaining correct information about some parts of a paper-mill, he took pains to visit a mill, at the distance of fifty miles, between Saturday evening and Monday morning; this being the only time he could spare from his work. After the expiration of his apprenticeship, he was employed on various works, and his reputation was constantly increasing in his little circle, until he attained the age of forty. It was at this period of his life, that the duke of Bridgewater required his assistance for his projected canal. Here his genius found its proper field, in planning and executing that great work. He, however, accomplished all the parts of his undertaking, in a manner, not only satisfactory to the duke of Bridgewater, but with such display of talent, that succeeding engineers have constantly referred to his works as models for imitation. The strength of his genius is made the more apparent, when it is considered, that his profession, more than most others, requires mathematical learning, and that he was so wholly illiterate, that it is yet in some degree disputed, whether he could even read or write. When any great effort of his mind was required, it was his custom to retire to bed, where he remained until his task of invention was accomplished, which sometimes lasted two or three days; when he would get up and put his design at once into execution. He kept his attention so unrelaxingly fixed to the subject of his profession, that having been prevailed upon once, when in London, to go to a play, he declared afterwards, that he would never repeat the experiment, as the spectacle produced such a distraction of his thoughts, as to unfit his mind for its proper actions. An answer of his, to a committee of the house of commons, shows strongly his singleness of purpose. Having, at an examination of some points relating to canals, spoken lightly of the use of rivers for navigation, he was asked, what he thought rivers were made for? after a moment's hesitation he replied; "to feed canals with." Mr. Brindley died at the age of fifty-six years.

this purpose. The aqueducts on the Middlesex canal, although built but about twenty years since, have not only required large repairs, but, we believe, one of the most expensive of them has required to be rebuilt.

We are happy to see that a sounder judgment or richer means, has directed the execution of these works on the great western canal, and we may instance the aqueduct which conveys that canal over the Genesee river, as worthy of imitation in other rising works. This aqueduct, as appears from an account by Mr. Bates, engineer for the section of the canal in which it is situated; is about 800 feet long, crossing the river with 11 arches, most of which are of 50 feet chord. The piers are of no very magnificent height, but are substantially built. The whole fabric is of hewn stone, and sufficiently massive to give it durability. It was built with the rapidity which characterizes our countrymen in all their undertakings: it having been completed in little more than one year from its commencement.

A very important improvement was made, in England, a few years since, in constructing aqueducts. We shall give the history of this invention from the excellent article, *Navigation Inland*, in the Edinburgh Encyclopædia.

"But about the year 1795, Thomas Telford, having been entrusted with the management of the Shrewsbury and Ellesmere Canals, had his attention drawn to the construction of some large aqueducts, and having observed, in some instances, the masonry of aqueducts where puddle was employed, to be cracked, and very subject to leakage, and some parts not unfrequently obliged to be taken down and rebuilt, or tied across by strong iron bars; these circumstances led him to consider of introducing cast-iron work. This he did, in the first instance, upon the Ellesmere Canal at Chirk, where the aqueduct was 600 feet long, and 65 feet high above the river; here he rejected puddle, built the spandrels over the arches with longitudinal walls only; across these walls, cast-iron flaunched plates were laid, as a bottom to the canal, and also on purpose to bind the walls horizontally; these were well jointed, screwed, and caulked; the sides of the water channel were built with stone facings, and brick hearting laid in water lime mortar. By this mode, the quantity of masonry was much reduced, yet the whole remains water-tight and substantial, after being worked 20 years.

"About the same time, and on the same canal, it was found necessary to cross the river Dee, at the bottom of the celebrated valley of Llangollen, at Pontcysylte; at the height of 126 feet 8 inches, above the surface of the river, and for 1000 feet in length, it was cheaper to aqueduct than embank. Here Mr. Telford introduced a still more decided deviation from the usual form, by building upright piers only, and, instead of masonry arches, putting cast-iron ribs between them, constructing the canal part by cast-iron flaunched plates for the sides as well as the bottom, and in order to preserve, as much as possible, of water-way, projecting the towing path over the water in the canal. The canal part is 12 feet in width, which admits boats of 7 feet beam, and a towing-path. This aqueduct has

now been worked about 15 years, and has answered the purpose for which it was designed; where the embankment commences, the height is 75 feet, but gravelly material being very convenient, rendered embanking cheaper than carrying the masonry and iron-works any farther.

"In the three magnificent aqueducts recently constructed upon the Edinburgh and Glasgow Union Canal, the modes of the two last mentioned aqueducts are combined, that is to say, the masonry of the arches and spandrels are preserved, as in Chirk, and cast-iron plates for the bottom and sides, as in Pontcysylte, are introduced within the masonry; how far it was judicious to incur the expense of providing two modes of security in the same structure, appears rather questionable. In Pontcysylte the upper parts of the piers only are hollow, with one cross wall in each; in the Union Canal, the piers are brought up hollow, with cross-walls from the foundation; this mode, with an equal quantity of masonry, embraces a greater extent of base, and having more external and internal surface, ensures better materials and workmanship."

An inquiry, preliminary to every other, regarding the practicability of forming a navigable canal through any tract of country, is, whether a sufficient quantity of water can be obtained to supply the elevated sections.

The supply must be not only enough for the locks, but for the waste by evaporation, leaks, and percolation through the bottom and walls. These last are, however, so inconstant, varying from the workmanship of the canal, the nature of the soil, the climate, and other causes, that no accurate estimate can be made of their amount, which could serve as a rule of general application. The accession of water to the canal, from rains, although it may in quantity equal the evaporation and leakage, must not be relied upon as forming a compensation to them; as in some seasons, a canal might suffer severely from a long continued drought. In considering this subject, in connexion with the practicability of supplying canals with water by the steam engine, we may take as an example, the water required to supply the Middlesex Canal. The line of this canal, which runs from Concord to Charlestown, a distance of 22 miles, is supplied by the water which flows through an aperture of 6 feet by 1 foot. The head of water being 2½ feet above the middle of the aperture, the mean velocity of the stream issuing from this aperture is, consequently, 9 feet per second, nearly. This gives to the canal 3240 cubic feet, or 2,015,000 pounds of water per minute. A good steam engine will raise 40,000,000 pounds one foot high, with every bushel of coal consumed; consequently, to raise the above supply of water 20 feet high, by the steam engine, would require an expenditure of fuel, equal to 1 bushel of coals per minute. Notwithstanding this, however, there may be situations where the advantages of a canal will prevail against even this expense, and in fact, in a few instances, in England, the summit levels are, wholly or in part, supplied with water raised from neighbouring fountains by the steam engine.

We have not room to go into the subject of the great change, so

often attempted, in the mode of moving boats on canals; we allude to the attempts to apply the steam engine to this purpose. It will be recollected, that the first experiments, for propelling boats by the steam engine, were made on canals. These resulted in failure, and many different plans, tested since, have terminated in the same way. Indeed, the difficulties of propelling canal boats by the steam engine, must strike any one, who attends to all the circumstances connected with it, as great, if not insurmountable.

Directions for bending, blowing, and cutting of Glass, for chemical and other purposes. Extracted from Chemical Manipulation. By Michael Faraday, F. R. S.

(Continued from page 222.)

52. A more delicate operation than any yet described, and one that requires considerable practice for its performance with even moderate success, is, the blowing of bulbs and other expansions, either in the middle or at the end of a tube. Facility will be best obtained by practising with a piece of tube about nine or ten inches in length, one-third of an inch in diameter externally, and one-tenth of an inch in internal diameter. The end is first to be closed; and then about two-thirds of an inch in length, of the closed extremity, is to be uniformly heated, until so soft as to bend from side to side by its own weight. The aperture is immediately to be placed between the lips, and by means of the mouth, air is to be propelled, for the purpose of expanding the soft glass. This must be done quickly, but cautiously; and as soon as the eye, which must be constantly fixed upon the heated end, perceives enlargement there, the force exerted by the mouth should be slightly diminished, and the operator should hold himself ready for its instantaneous cessation: for if the power which expands the glass at first, be continued in full force, the glass will suddenly burst out into a large, irregular, thin bubble, of no use. This follows as a natural consequence, for every enlargement of the bubble diminishes its thickness, and, consequently, its resistance, and at the same time increases its internal area, and in that respect increases the power of the air impelled into it; and if the enlargement take place quickly, so that the glass has not time to cool, it cannot but happen that the bubble should expand to a large size. To avoid this, air should be thrown in from the mouth only, and not from the lungs; as the glass expands, the force with which the air is impelled should be diminished: and the operator should not endeavour to finish the bulb at once, but having succeeded in expanding it to such a size that the internal diameter is five or six times the thickness of the glass, he should heat it again, and complete the bulb at a second operation.

53. The glass must never be blown whilst it is in the flame, for it is impossible to make it retain a uniform temperature there, but is always to be expanded in the air: as it swells, it must be continually

turned, and those parts which are thinnest brought to the lowest position; they are easily recognised by their sudden expansion, by a greater degree of transparency, and a peculiar reflexion from them, different from that of the neighbouring parts. They are directed to be brought into the lowest situation, because the glass in that position cools most rapidly, and, consequently, its further extension is prevented. The operation, to be good, must be quick, for the temperature of the thin glass is so soon lowered, that it cannot be done at all if not done rapidly. The bulb, when finished, should be round, set straight on the end of the tube, of uniform thickness at the bottom and sides, and without lumps and knots. The size will vary with its thickness, and the quantity of the glass heated.

54. These operations may then be repeated with tubes of different sizes. If their internal diameters are much smaller than that mentioned, as in barometer tubes, the end may be heated until almost solid, and even thrust up into a lump. This being uniformly ignited, should be blown until the air just begins to expand into a small bubble at the end of the bore, and then the temperature of the glass being well raised, it should be blown out into a bulb at once, being turned in the air, as before directed, during the operation. It will be understood from what has been said, that these bulbs will not serve for thermometers, because of the moisture they receive from the air thrown in by the lungs; but they are useful in the practice they afford, and for numerous experimental purposes.

55. Sometimes an expansion must be formed in the middle of a tube, and the operation, in general, resembles that just described. If the end of the tube be closed, the glass merely requires to be thickened and heated at the part to be blown out, and then expanded by the breath. If it be not closed at either extremity, then the finger or a cork must be applied at one end to close it, and the part being heated, the lips are to be applied to the other end, and the expansion made.

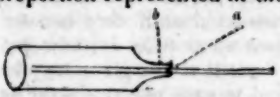
56. A little practice of this kind will soon enable the student to remove the knots at the ends of his closed tubes, (31) and make their terminations perfectly round, and of a uniform thickness. By similar trials he will succeed, perfectly, in forming little vessels, some of which are blown out of small tubes, whilst others may often be made without any blowing at all. For this purpose it is only necessary to take a piece of tube of proper diameter, or, if too large at first, it must be drawn down to the diameter required, (29) and contracting one part into a neck of such width as is necessary to be given to the intended vessel, (30) the flame is afterwards to be removed further down, to fuse the glass, which is to be contracted, drawn out, and closed. In this way, the body of the vessel is obtained of any required capacity, according to the length given to the piece of tube forming it. Or by warming the body, and then blowing it, it may be expanded until of a much larger size. The flask is afterwards to be separated from the remaining piece of tube, either by cutting it off with a file, (19) or drawing it off at the lamp to a fine termination, if required.

57. Two pieces of tube are sometimes to be melted together, so as to form one, with a continuous bore; and pieces of the same, or of very different thicknesses, may, if necessary, be joined. The ends should be straight, and of nearly equal diameter, so as to apply almost accurately against each other. If they are not so at first, the extremity of the larger one should be contracted until they become so. They should be brought into the flame so as to be raised separately, but, at the same time, to a good heat, that the glass may be quite soft; and then the ends, being applied to each other, should be pressed together in the flame, until the glass adheres in every part, and runs up into a ring round the tube. The ring should be immediately drawn down again, unless it be permanently required, and then, by working the glass in the flame, the joint should be brought into a good shape and condition. If, during the operation, the tube contract, it should be blown out (55;) if it become thin, it must be thickened (35) and pushed up; if it be thickened too much, it must be pulled out and rendered thinner, the contraction of the diameter occasioned by doing so being rectified by expanding the glass again. The joint, when finished, should not be of imperfect adhesion at any part, or be distorted in form, or involve any great irregularity of thickness, for then it will, almost certainly, fly asunder when cold. Small irregularities may be allowed to remain, and if the glass be well annealed, will do no harm.

58. It is of great importance in many experiments, to be able to seal a metallic wire into glass, so that the glass shall close round it and adhere to it, in a manner perfectly air-tight and sound. The detonating eudiometer tubes, and the tubes for the collection of gas, during the voltaic decomposition of liquid substances, or solutions, are common instances of their valuable application. Platina is the only metal which answers well for this purpose, and fortunately it is that which, in consequence of its chemical relations, is the most useful in such situations. The superiority of platina, depends upon its infusibility at the temperatures required to work the glass, and on the close agreement of glass and platina, in the rate of their expansion and contraction by changes of temperature. Other metals, as iron, differ much from glass, and when wires of these are inclosed in the most secure manner, they either separate, when cold, from the glass, by contraction, destroying the continuity all round them, or, if that does not take place, they retain the glass, in the immediate neighbourhood, in such a state of tension, that very slight accidents cause it to fly, and cracks to proceed from the wire into the glass, in several directions. This rarely happens with platina inclosed in the thickest glass, if the junction has been good, and the glass well softened.

59. Suppose a tube like that figured to be required, with a platina wire passing through it, and hermetically sealed into its summit. A piece of tube of the required diameter, thickness, &c., is to be selected, and also a piece of clean platina wire: the tube should be heated at the part where it is to be closed, and should be drawn out, so as to form a capillary neck, (35, 44) the end of the tube and the

neck being preserved of considerable comparative thickness, so that no occasion for afterwards increasing it shall exist. The neck should be of such internal diameter as freely to receive the wire, but no more; and, when cold, should be cut with a file, so as to leave the proportion represented in the figure, attached to the tube. The wire



is to be introduced through the aperture thus opened, and placed in the position required, when the tube shall be completed. The point of the flame is then to be applied first to *a*, that the extremity of the aperture may become heated, and the wire also, the temperature being kept down to such a point as is sufficient to soften the glass considerably, but not to make it run; and both glass and wire being hot, a very little motion of the latter will cause the edge of the former to adhere to it all round, and make a tight, though not a strong joint. This done, the heat must be applied more towards the tube, so as to make the glass and the wire adhere gradually from *a* to *b*. This should be done without any twisting or distortion of the glass, and will be found more or less easy, according as the end of the tube has been well or ill prepared at first to receive the wire. Finally, all that part by which the wire is surrounded and held, should be raised to such a temperature as to make the glass soft and semi-fluid, that no irregularities in form or contraction may remain; the wire should be arranged so that it passes directly down the axis of the tube, and then the whole must be suffered to cool. It is erroneous in a beginner, to make the capillary end of his tube thin, and trust to thickening it after the wire is sealed in, by running the glass up. Such sealings are generally unsafe. The end of the tube should first be made of sufficient thickness, and then all that remains to be done is, to soften it so that it may collapse round and adhere perfectly to the hot wire, in every part of the joint.

60. When a tube of this kind is required for voltaic decompositions, having two parallel, but insulated wires sealed into its closed extremity, then a piece of platina wire, of sufficient length for the two, is to be bent in the middle, so that the parts may be parallel, at the distance of the eighth or the twelfth of an inch from each other. The extremities are to be fixed into a small piece of cork, which will retain the bent wire so steadily, that it may be worked with as a single piece. That part of the wire which is intended to pass through the end of the tube, and to be fixed in the glass, is to be brought into the flame of the lamp, and a thick filament of glass, or a thin rod, being held in the hand, its extremity also is to be softened in the flame, and glass from it worked upon the wires, so as to form a small bead, which, lying between them, shall also extend outside of, and inclose them on two of its sides, and, when cold, serve to tie them together, at the distance before arranged. This done, the end of the tube is to be prepared by drawing it down and contracting it, but only so much, that when the neck is cut off, (which should be done closer to the tube than in the former case) the aperture may be so large as to admit the passage of the double wire, but not of the bead

of glass upon it. The wire is to be dropped down the inside of the tube, so that its bent end may pass through the aperture, and the glass bead be received and stopped just within it; heat is now to be applied, to melt the bead and the end of the glass tube together, and the temperature is to be raised until the cohesion is perfect, and the joint well formed, after which, it must be allowed to fall. When the tube is cold, the piece of cork, now within, is to be drawn from the ends of the wire, and the wire itself is to be divided on the exterior, at the bend. It thus forms two insulated portions, which may be connected with the poles of a battery, and rendered active, in decomposing any solution put into the tube.

61. If a wire is to be inserted through, and sealed into the side of a tube, that part of the tube through which the wire is to pass, is to be softened in the lamp, and the wire pressed against it, until it appears in the interior of the tube: it should then be drawn out again in the same direction, and both tube and wire left to cool. The wire will be found coated with glass, which may be easily broken off. The tube will be drawn out at the place forming a conical projection, the end of which, when broken off, will afford a passage to the interior. The wire is then to be put into the aperture, heated, and the glass fused around it: ultimately the wire is to be pushed inwards, until that portion of glass which projected has been returned nearly to its first position. By a little practice, this may be done, so that the glass shall be in perfect contact with the wire on all sides, and with little disturbance as to its form, or the position from that which it possessed at first, the wire, at the same time, having the exact position required. If fears be entertained that, from the removal of glass on the wire, and by breaking off the end of the projection, enough will not remain to confer sufficient strength upon the tube in that part, it will be desirable, to put a bead of glass round the wire, in the manner just described, for double wires, and when the heat is applied, to work it into contact with the glass of the tube, that the latter may be of sufficient strength. When two wires are required in the same tube, at a certain distance from each other, as is necessary in a eudiometer, the distance is easily regulated by a little previous consideration; allowance being made for the extent to which the wires will require to be moved, before the operation is finished, and they are finally fixed in their places.

62. When green bottle glass tubes are to be worked and submitted to these operations, they will be found of more difficult performance, because of the much higher temperature required for the fusion of this glass. Generally, it is only the simpler operations that are necessary with green glass, such as bending, closing, or lengthening a tube. These may be performed readily, by means of the table blow-pipe; and as, from the greater strength and infusibility of green glass, it frequently happens, that a thinner tube may be used of this substance, than of flint glass, a greater facility in the operation is thus obtained.

63. The use of the spirit-lamp in these operations on glass, even when not urged by a blow-pipe, has been noticed more than once.

When its powers are increased by the application of the blow-pipe, it may often be made to perform the work of the table-lamp; generally not so well, though very usefully; sometimes quite as well; occasionally even better. Small tubes may be bent, closed, drawn out, extended, and worked, in almost any way by its means; and moderately large tubes, viz. from one-third to half an inch in diameter, may be bent and closed by it. If no other kind of blow-pipe than that of the mouth be at hand, it must be turned to account in the best manner possible. For this purpose, the mouth-piece of the blow-pipe may be placed between the lips, and the instrument supported without any help from the hands, being allowed to hang from the mouth with its jet opposite to the flame of the spirit-lamp. The flame may then be urged, whilst both hands remain at liberty for the purpose of moulding and working the glass. The student will, at first, find it difficult to hold the blow-pipe so steadily in his mouth, as to produce a certain and regular flame; but he may obtain assistance by placing a block of wood, a book, a weight, or a brick, upon the table, between himself and the lamp, at such distance from the latter, that the back of the blow-pipe may bear slightly against it. The pressure may be easily regulated by the mouth, and will be quite sufficient to render the blow-pipe, and, consequently, the flame itself, perfectly steady.

[TO BE CONTINUED.]

ENGLISH PATENTS.

To CHARLES PHILLIPS, *Captain in the Navy, for improvements on Capstans.* Dated June 8, 1827.

THE improvements on capstans, stated in the specification of this patent, are intended for a species of double capstans, for which captain Phillips had before obtained a patent. These double capstans consisted of two capstans on the same spindle, which were, of course, to be worked on two different decks, and the upper capstan of which was fixed to the spindle, while the lower one might be turned round independent of it, but had a clutch-box placed over it, that was moveable only upwards and downwards on a square or hexagonal portion of the spindle, and which, when let down, connected the lower capstan with the spindle, but when raised up again, left it at liberty: beneath this lower capstan, a stout pinion, or small toothed wheel, was fixed to the spindle, whose teeth interlocked with those of three other similar pinions of the same size, placed at equal distances round it, which were supported by a disk of metal, that revolved round a turned part of the spindle, and had another disk above them to keep them steady, and were connected to the two by their axles, which entered into both a sufficient distance; the teeth of these three outer pinions were again interlocked with those of an internally toothed ring, that surrounded the whole, and which was

fastened in four opposite places by projecting pieces to a circle, or thick ring, that was fastened to the deck beneath the capstan, and in the edge of which the notches were made, in which the falling palls of the capstan entered. This machinery, (first used for the same purpose as what is called the sun and planet wheels, employed by Mr. Watt, with the momentum wheels of steam engines,) by being made to act in a reverse order, gives a great increase of power to the lower capstan, accompanied by a proportional diminution of velocity; which renders it expedient only to employ the whole power of the engine, when very great resistances are to be overcome, and at other times, when less force is required, a degree of it better suited to the purpose may be obtained, by lowering the clutch-box, and thereby uniting the two capstans, and, at the same time, withdrawing the lower bolts, that connected the lower capstan with the multiplying machinery.

In the former arrangement of the capstans, the clutch-box was worked by two balance-levers, placed above it in the direction of the opposite radii of the capstan-head, and supported at their centres by two uprights that arose from the top of the lower capstan, the inner ends of which were fastened to the clutch-box by chains or loops, while chains descended from their outer extremities to two vertical bolts, that passed downwards through the bottom of the lower capstan, in the space between the whelps, into holes prepared for them in the upper disk, belonging to the three external pinions of the machinery before explained: and by this means, when the clutch-box was lowered, the bolts were drawn out by the rising of the outer ends of the levers, which this occasioned, and the multiplying machinery ceased to be connected with the lower capstan.

The improvements comprised by the present patent, relate to this latter part of the apparatus, all the other parts being the same as before; and, according to the directions given respecting them, the clutch-box and levers are to be superseded, and a plain disk to be fastened to the spindle of the double capstan in their stead, through which two strong vertical bolts being let down into the head of the lower capstan opposite to each other, connect it with the spindle when required; and again, when these bolts are drawn up, the lower capstan becomes separated from the spindle. These bolts, when raised, are prevented from descending again, until required, either by pins, that pass through holes made in them, or by catches which embrace annular cavities formed round their middles. Instead of the disk, a straight bar may be also used for holding these bolts, furnished at either end with vertical perforations for that purpose, and having a square or hexagonal cavity or enclosure, at its middle, by which it is fastened to the spindle. The vertical bolts at the bottom of the lower capstan, are to be raised by hand, when the upper ones are let down. This arrangement the patentee thinks preferable to the first, on account of its greater simplicity, and from its giving the two capstans a greater range in their operations. [*Repertory.*

To EDWARD BARNARD DEEBLE, *Engineer, for his new construction or constructions, combination or combinations, of Metallic Blocks, for the purposes of forming caissons, jetties, piers, quays, embankments, light-houses, foundations, walls, or such other erections, to which the same Metallic Blocks may be applicable.* Dated July 12, 1827.

MR. DEEBLE'S metallic blocks, are cases, made of cast-iron or other fit metal, of various forms, according to the uses for which they are intended, from some of the vertical sides of which, dove-tailed ledges project, while in others of their sides corresponding dove-tailed grooves are formed; by slipping down the first of which, belonging to some of the blocks, into the latter belonging to others, the whole may be connected firmly together, into the sort of erection best suited for the work required; some idea of which mode of connexion may be obtained by observing the manner in which the pieces of the dissected maps, intended for uniting instruction with amusement for youth, are combined together.

In the drawings of the specification of this patent, twelve figures are given, of what may be called the elementary forms of these metallic cases; one of which, intended for straight walls, is a rectangular oblong prism, with a projecting dove-tailed ledge at one end, and a dove-tailed groove in the other extremity, for connecting pieces of this shape as mentioned; another form, designed for curved walls, is a triangular prism; a third, is a hexagonal prism; both of which have grooves and ledges as the others, but differently disposed: a fourth, of a more complicated shape, has a flat bottom, or one slightly curved, straight sides, and an arched top, at the upper part of which a dove-tailed groove is made, which is intended for the reception of two dove-tailed ledges of half its size, formed on the extreme angles of the bottoms of two other cases of the same shape; by which construction, when several of these cases are united, they present an appearance slightly resembling the vertical section of a honey-comb; and a fifth sort has a large re-entering angle at one of its sides, into which parts of one or two other cases may be fastened by grooves and ledges. By which combination, variations of the shape of the walls may be produced, as may be required; and the rest of the twelve figures are varieties of the others, showing different dispositions of the grooves and ledges, and of other parts, as best suited to various kinds of work.

Fifteen figures are exhibited, of the several combinations of these elementary forms; two figures represent simple connecters for the cases, used on some occasions, one of which is a double dove-tailed ledge, for uniting two cases by their opposite dove-tailed grooves; while the other consists of a dove-tailed groove in the flat side of a small semi-cylindrical prism, by which two half dove-tailed ledges on the adjoining angles of two cases may be firmly clasped together. And three more figures (which make the number of the whole amount

to thirty-two) show the construction of a species of tackle, that the patentee has contrived, for lowering his metallic blocks into the sea or other depth; or for elevating them to a higher level, as may be found expedient.

The cases, for some purposes, may be made open at one side, or at two opposite sides; and instead of having solid sides, may have them constructed of open work of various devices. The thickness of their sides may, likewise, be varied from that of half an inch, to the extent of one or more feet; and though cast-iron is the substance in most instances contemplated by the patentee for their formation, he, however, claims the use of other metals or alloys, for the same purpose, if he shall give them a preference. The internal hollows of these cases, are to be filled up with stones or bricks, along with common mortar, or tarras cement, as may be best suited to the uses for which the erections made by them are intended; and as among the several applications of the cases, the patentee expressly designs them for the construction of caissons for erecting the piers of bridges, he states that, on this or other occasions, he claims the use of piles, both within their hollows, and outside their faces, for the more firmly connecting them with their foundations, and making the latter more substantial and unyielding. The metallic cases of a rectangular form, without tops or bottoms, are chiefly to be used for these caissons, and their hollows are to be filled with clay, or other substances commonly employed between the enclosures of caissons formed of piles, instead of the materials directed to be used for this purpose on other occasions.

The "tackle," or apparatus, contrived by the patentee for raising or lowering down the metallic cases, consists of two strong bars of wood or iron, united at their centres by a pivot, which permits their ends to be separated from each other at any angle; four strong cords, or chains, ascend from rings placed near the extremities of these bars, and are joined above to a box of pullies, which, by a rope properly passed through them, are connected with similar pulleys on the top of shears or some other support, in the usual manner; from the middle of each of the internal sides of each case, near its top, pieces project an inch or two, under which the ends of the cross bars are put, and the cord of the tackle being then pulled by any adequate force, will draw the case upwards, so as to be supported entirely by the tackle; from which situation, on the case being lowered down and adjusted in the place where it is to remain, the bars are made to disengage themselves from the projecting bits on its inside, by means of two short bars of equal length, that are connected to two of the ends of the sustaining bars, which are next to each other, and to each other by joints, and a cord ascending from the latter joint, which is in the middle between the other two; by pulling this cord, any of the workmen near the shears may cause this middle joint to rise, and will thereby bring the ends of the sustaining bars sufficiently close to each other, to make them pass sideways from under the projecting bits of the case; and will thus entirely free the tackle

from it, so as to be ready for a similar application to another case, as soon as may be required.

In joining a number of the cases to each other, in the construction of a wall, they may be so placed that the joints of one row may be opposite to the centres of the cases in the adjoining rows, as bricks are arranged in ordinary walls; by which the fabric will be connected together with more firmness and solidity.

OBS.—There is much ingenuity exhibited in the forms of Mr. Deeble's metallic cases, and in the means used for connecting them together; it is, therefore, with much regret, we have to remark that cast-iron, which is the only material that could be cheap enough for their construction, is very unfit for works that are to be covered by the sea, as it is affected in a very extraordinary, and as yet unaccountable manner, by sea water, so as to have its consistence entirely destroyed, and be reduced to a state in which it may be cut by a knife; as has often been proved by the condition in which cannon are found, that have lain any time at the bottom of the ocean, from shipwrecks or other causes: and we even recollect an account being published a few years ago, of some cannon so situated, the pieces taken from which grew so hot on being taken up and exposed to the air, that they could no longer be handled; which showed that the cast-iron was converted into a species of pyrophorus, by the action of the sea water.

Any other metal but iron, would, evidently, be too expensive for the construction of these cases, and we also think that malleable iron could not be obtained sufficiently cheap for them, though the only metal of whose fitness for the purpose there could be any rational hope, for the reasons we have given. [*Ib.*

To PIERRE ERARD, *Musical Instrument Maker, for improvements in the construction of Piano-fortes: communicated by a Foreigner.* Dated 20th February, 1827.

THE object of this patent is, to extend the improvements on grand piano-fortes, for which Mr. Erard obtained a patent in 1825, to those of a square form, and of other shapes, and also for some additions to, and variations of those improvements.

The hammer, or part that strikes each string, has its centre of motion in front, and the key on which the finger is pressed, extends considerably backwards beyond its head; the farther end of this key is kept down by a spring which keeps the outer part at a due elevation for the action of the finger, and a balance lever, a few inches in length, runs along the top of its inner extremity, on which it is fastened to two small metal uprights by a pivot, which passes through the three, so as to allow it to move freely up and down a short distance; a strong wire bent at right angles, whose lower end is screwed into the frame, rises above the farther end of this lever, and turns

over it beyond its angle, at a proper distance, to stop it from rising farther, when it is thrown into contact with it by the action of the finger, and to cause the near end to fly up; and by a vertical striker, which ascends from it to drive up the hammer with increased velocity, by striking its stalk pretty close to its centre of motion. Which arrangement altogether gives sufficient length of lever, from the combination of the leverage of the key, of the hammer, and of the upper lever, to cause the head of the hammer to strike the string with sufficient velocity, while the key itself is so much shorter than usual, as to admit of a considerable reduction of the breadth of the instrument. This account will serve to explain the principle of the action of the key, but its simplicity would little accord with Mr. Erard's apparent love of complication, and he has, accordingly, added to the key, besides the parts we have mentioned, two short levers, and springs, above the first, holding a second striker, (which acts in raising the hammer for part of the distance, while the first completes the stroke, and which is detached by a contrivance for the purpose, as soon as the first begins to act,) and a catch, with a wedge-shaped top, that passes by the stalk of the hammer, and prevents it from rebounding; a damper also, that is pressed against the string by a combination of three or four pieces between it and the end of the key, is elevated by the latter, when pressed by the finger; so that each key sustains a little forest of levers, springs, catches, and intermediate parts. A method is besides mentioned, of connecting a damper of the common form, with the key, which completes this part of the instrument.

The rest of the specification relates to the frame work beneath the sounding board; which consists of several strong parallel pieces of wood, placed a small distance apart lengthways, and tenanted into other pieces, that go across the instrument; and of longitudinal bars of iron, which the patentee calls "arcs," that are kept above the sounding board by iron uprights, which are screwed to the long parallel pieces of the frame in several places.

The instrument is entirely open at the bottom; and the hammers are fastened to hinges that are placed alternately in two different rows of elevation close to each other, which permits the hinges to be of greater breadth, so as better to prevent lateral motion, than could be effected if they were placed in one row. The pins that hold the strings, pass through metal plates, screwed to the frame, but this the patentee does not claim as his invention, and the other parts of the instrument, not particularly described, are to be made in the usual manner, according to the peculiar shape for it required.

OBS.—The remarks on Mr. Erard's patent for improved piano-fortes, granted in 1825, (which may be found in the 1st volume of our present series, p. 114,) will also, for the most part, apply to the present patent, particularly with regard to the complicated apparatus placed on the ends of the keys; which, with the springs, would, we think, make them require as much force to press them down as those of some church organs. We have, however, ascertained, that the

longitudinal bars and iron braces added to the frame of a piano, do not injure the tone of the instrument, as we first apprehended, having examined one of the large species so constructed, in company with a very experienced musician; but as none made on the present patent were ready for inspection, we can say nothing of these from actual examination. [*Ib.*

Abstract of the Specification of a Patent granted to JOHN *and* SAMUEL SEAWARD, *Engineers, for a new or improved method or methods of propelling Boats, Craft, and all kinds of Vessels on Canals, Rivers, and other Shallow Waters; and also Locomotive Engines, Vehicles, and other Carriages on Roads.* Dated November 1, 1825.

OUR said invention of a new or improved method or methods of propelling boats, craft, and all kinds of vessels on canals, rivers, and other shallow waters, and also locomotive engines, vehicles, and other carriages on roads, is fully described and ascertained in manner and form following: First, our method or methods of propelling boats, craft, and all kinds of vessels on canals, rivers, and other shallow waters, consists in employing a wheel or wheels to turn or revolve upon the bottom of the canal, river, or other shallow water, or against the sides thereof, and by that means propel or draw, according as the wheel may be placed, the floating vessel forward, to which the said wheel or wheels may be attached.

The wheel or wheels above mentioned we call propellers; and when necessary to guard against it or them from sliding on the ground without proceeding forward, we arm the periphery with projecting knobs, or other contrivances, well known to engineers, by which means the propeller will catch firmly hold of the ground, and propel the vessel with adequate force. Or the propeller may be formed of a boss on its axis, with a circular series of projecting arms or radii, similar to a wheel without its periphery. In general we employ only one propeller for a boat or vessel, and place it in an opening or well through the bottom of the boat or vessel; the well of course closed all round to prevent the admission of water into the boat or vessel; it may, however, be placed at the sides without passing through the bottom of the vessel, or at one or both ends, as may be found most convenient; and instead of one, two or more propellers may be used, placed in suitable situations, either in a vertical, horizontal, or oblique position, to turn or roll on the bottom, or against the sides of the canal or river. The methods of connecting or attaching the propeller to the vessel or boat, and giving it a rotary motion, are various; we shall, however, proceed to describe two or three ways, which we prefer employing for that purpose.

If the bottom of the canal or river is level, and the depth of water

every where the same, it will be sufficient to hang the propeller on a suitable shaft, moving in fixed bearings, such as the crank shaft of a steam engine, or other moving power, and, if the propeller be made of suitable diameter to touch the ground or bottom, it will by its rotary motion, cause the boat to advance. If the bottom of the canal or river is uneven, the projecting arms, radii, knobs, or other contrivances used for this purpose, may be made to slide in and out of hollow spokes freely of themselves, by which means the diameter of the propeller will accommodate itself to the unevenness of the ground.

When the depth of water is various, or the bottom very irregular, we employ a hanging or swinging frame, one end of which frame is attached to the crank shaft of a steam engine, or other moving power, and allowed to swing freely thereon. To the other or vibrating end is fixed the propeller by means of a shaft or axis, running on suitable bearings; by this means the propeller will rise or fall, and accommodate itself to the various depths of water, or to the inequalities of the bottom of the river or canal: or the ends of the axis of the propeller, or the bearings in which they work, may be made to rise and fall in circular grooves, concentric with the crank shaft aforesaid; and other similar contrivances may be adopted to cause the propeller to adapt itself to the depth of water.

To give the requisite rotary motion to the propeller when employed with the swinging frame, circular grooves, or similar contrivances, we employ two drum wheels, one fixed on the crank shaft, and one on the axle of the propeller, with an endless band or chain, by which the necessary motion will be communicated; though tooth wheels and many other contrivances may be employed for the same purpose.

We claim as our invention the propelling boats, craft, and all kind of vessels on canals, rivers, and other shallow waters, by means of a revolving wheel or wheels, arms or radii, working either on fixed centres, on swinging frames, in circular grooves, or with other suitable contrivances, and rolling or turning on the bottom, or against the sides of canals, rivers, or other shallow waters; however, or by what means soever the said wheel or wheels, arms or radii, are made to revolve or turn round.

To WILLIAM JOHN THOMPSON HOOD, *Lieutenant in the Navy, for improvements on pumps, or machinery for raising or forcing water; chiefly applicable to ships.* Dated May 26th, 1827.

To form the apparatus, for which this patent has been obtained, an air-tight case, or coffer, about six feet long, five broad, and two deep, formed of boards grooved and tongued together and secured by screws, is fixed immediately under the middle of the lower deck of a ship. This case is divided longitudinally into two equal parts by a vertical partition, and one of these is again separated into three compartments by two similar partitions that pass across it at right

angles to the first; from the middle one of these last mentioned compartments a square wooden trunk, or a metal tube, whichever be preferred, is carried down to the kelson, and as the middle compartment need be but little larger than what will admit this tube, it of course is the smallest of the three; the lower part of the trunk or tube is surrounded by gratings, sloped downwards at each side of the kelson, and continued across the space underneath the limbers, to prevent solid bodies of any sort from entering into the tube, which is furnished with a valve opening upwards similar to that used in other pumps. From the two compartments at each side of the middle one, tubes ascend above the lower deck furnished with solid pistons, the alternating motion of which, effected as will be described, raises or forces the water as required; and from the large compartment left in the first division of the coffer, two other tubes ascend above the deck, over which the water is to pass on its way to the scuppers, and are intended merely for conveying the water from the coffer, but are furnished with valves opening upwards to prevent its return.

To work the pistons in the two tubes that contain them, a vertical wheel is placed above them of such a size, and in such a position, that the ends of its transverse diameter are directly over the centres of the two tubes, and to this wheel chains are fastened, which pass over its periphery at each side to the pistons; and these chains being of such a singular structure, (which, however, is not explained in the specification,) that when pressed down by the motion of the wheel, they become equally unyielding as a piston rod, they, of course, press down the pistons with the same facility that they draw them upwards; and large vertical valves, that open outwards, being placed at each side of the middle compartment, from whence the tube descends to the kelson, and two other similar valves opening into the large division of the coffer, from the two side compartments, it follows, that when the pistons are drawn upwards, they will raise water from below into the coffer, and when they are pressed down, that they will force it upwards from the coffer by the pipes that ascend from the large compartment. The large vertical valves are, it is stated, so constructed as to be detached from the coffer, without its being requisite to open it for this purpose, but the mode of doing this is not described with sufficient accuracy, for any practical purpose.

The wheel that works the pistons, receives an alternately reversed motion, by rods that ascend from the ends of its transverse diameter, to cranks on the upper decks, which are turned by hand, by the same sort of apparatus by which chain pumps are worked; and as these may be multiplied as required, and be made to act simultaneously by rods of communication, any force necessary for raising the water may be readily attained.

This water engine may be also converted into a machine for extinguishing fire, by closing the lower descending tube and the two ascending tubes by stoppers, which are worked by long screws that pass through the top of the coffer, and by turning cocks in pipes that

pass through from the coffer to the sides of the ship, and screwing on leathern hose to the top of the compartment.

OBS.—It appears to us, that the coffer used in this apparatus, would take up much room to very little purpose, and that if constructed as described in the specification, it would be kept watertight with the greatest difficulty, on account of the great pressure from within, that would take place when the pistons were pressed downwards, which acting on so large a surface, would constitute a force of more than 37 tons, operating to burst the coffer, if the water had only to be raised 15 feet higher than its surface. Any advantage that could be acquired by this apparatus, which appears to us extremely clumsy and cumbersome, would, we think, be obtained much better, and with infinitely less risk of derangement, by La-Hire's double-acting forcing pump, (an account of which may be found in most modern elementary treatises on hydraulics,) which appears to us to be peculiarly well calculated for ships, from its simplicity, and the facility with which it may be repaired in case of accidents.—*Ib.*

To HUGH EVANS, *Lieutenant in the Royal Marine Corps, and to* WILLIAM ROBERT HALE KING, *Tin-plate Worker, for a new Table Apparatus to promote the ease, comfort, and economy of persons at sea, or on nautical excursions.* Dated 12th June, 1827.

THIS table apparatus for the use of ships, consists of a deep ring, or hoop of metal, of a size proper for supporting a dish, to which is attached by joints several smaller rings, and other contrivances, for holding decanters, tumblers, wine glasses, knives and forks, and other dinner utensils, and also a strong screw clamp, by which the whole may be firmly fixed to a table.

The smaller rings are of different sizes, according to the purposes for which they are required; and the large ring being about two inches deep, to the top of which they are jointed so as only to have a lateral motion, there is a sufficient space left between them and the table, to enable them to have a fast gripe on the articles placed within their peripheries.

The contrivance for holding wine glasses consists of two half rings having a straight spring projecting from one of their extremities, (by which they are attached to the large ring by the sort of joint above mentioned,) and of other pieces curved outwards from their other ends, which serve as guides for the admission of the glasses into the circle formed by their conjunction, where these are retained by the action of the springs, which are so shaped as to be moveable only in the plane of that circle.

To hold knives and forks, strong wires project from the sides of the large ring, having two or more vertical loops of the breadth of the handles formed on them by flexure, by which loops one end of

each of these instruments is supported, while their other extremities rest on the table.

The clamp is so jointed to the large ring as to move in a direction at right angles to its plane; but only towards its centre from without, being prevented by a stop from moving farther outwards than is necessary for placing the ring level with the table. The screw of this clamp lies beneath the table, when it is properly fixed, and on being turned binds the ring to the table, so as to prevent it from separation by any of the motions of a ship. The joints of the several pieces attached to the large ring, are intended for the purpose of turning them round, so as to lie within its circumference, when the apparatus is not required for use; in order that the whole may occupy less space, and be laid by in a case or locker with more conveniency.

A clause of variations is added to the specification, to extend the number and form of the pieces jointed to the large ring, and the application of the whole to breakfast and tea services, and to other purposes, not stated, as well as to the retention of the utensils required at dinner.

OBS.—Messrs. Evans and King's apparatus appears to us to be well calculated for the purposes for which it is intended; though we cannot perceive any remarkable advantage that it has over the trays with two bottoms, the upper one of which is perforated with numerous apertures of different sizes, for the retention of the several vessels, and other articles required at meals, in a similar manner: the latter seeming to us to be equally capable of preserving them from precipitation and fracture, or sudden extraordinary rollings or pitchings of the ship, if only properly fastened to the table, which every seaman knows well how to do, without going to the enrolment offices for instructions.—*Ib.*

To JOHN ALEXANDER FULTON, *Spice Merchant, for his invention of a Process of Preparing or bleaching Pepper.* Enrolled May, 1828.

THE object of the patentee is, to remove the external skin or black coating from pepper, in order to render it white. The mode of effecting this object is, by steeping the pepper in water for the space of a day, or more, sometimes a week may be necessary; and then placing a considerable quantity of it in a heap, so as to become heated; in which process the skins will very soon rot or become decomposed, and readily separate from the peppercorns within them.

The decomposed skins may now be removed by washing the pepper in water, and agitating it until all the black part is effectually washed off. The pepper is after this to be dried by exposure to the air, or in any other way that may be found convenient for drying corn or seeds.

In order to bleach the peppercorns, after they have been treated as above, oxymuriate of lime may be employed, or it may be submitted to the fumes of sulphur. [*Lond. Journ.*

To FRANCIS HALLIDAY, *Esq. for his invention of certain Improvements in raising or forcing Water.* Enrolled February, 1827.

THIS is a sort of rotary pump, constructed upon the same principles as the rotary steam engine invented by the present patentee in 1825.

A wheel, carrying four vanes as pistons, works through the middle of a semi-circular chamber. One end of this chamber is open, and sufficiently wide to admit the broad faces of the pistons; the other end is closed, excepting at the narrow space through which the wheel passes edgewise, and fits tightly.

The wheel is proposed to be placed horizontally, and to turn in that direction upon a vertical shaft. The semi-circular chamber is, of course, horizontal also, and, with the wheel, is intended to be placed at the bottom of a well, or other reservoir, from which the water is to be raised.

The semi-circular chamber being immersed in the water, and open at one end, will, of course, be filled with water, and the vanes or pistons, as the wheel goes round, entering the chamber in succession, will shut in the volume of water immediately before it, and press the water towards the closed end of the semi-circular chamber, where, being unable to escape, it will rise in a perpendicular pipe leading upwards from that end of the chamber.

It has been said, that the semi-circular chamber, lying in a horizontal position at the bottom of the well, is open at one end, by which the water flows freely into it, but that it is closed at the other end, except a narrow channel through which the wheel passes edgewise, fitting the opening closely. Now each piston attached to the wheel, in entering the open end of the semi-circular chamber, presents its broad face to the volume of water, and its edges fitting the internal part of the chamber closely, of course, the volume of water is driven forward by the piston, until the piston next following enters the chamber, and brings forward another volume of water, and so on. When the first piston has performed its duty, that is, brought the volume of water forward, an arm on the outside of the wheel, attached to the axle of the piston, strikes against a projection, and turns the piston round edgewise, which shuts it into the face of the wheel, and allows it to pass with the wheel freely through the narrow channel at the closed end of the semi-circular chamber.

In this way the successive pistons will continue as the wheel revolves, to drive the volumes of water along the semi-circular chamber, and, consequently, to force it up the perpendicular pipe, by which means the water will be continually rising from the well, or reservoir below, to the discharge-pipe above, and so pass off at a higher level.

It is scarcely necessary to add, that the rotation of the wheel carrying the pistons, may be effected by means of bevel gear at top, and which may be driven by a winch or by any other power. [*Ib.*

Observations on the attempt to construct machines of the kind usually intended by the term Perpetual Motion; with notices of some of the particular machines which have, at different times, been proposed for the attainment of this object. By the Editor.

[With a copper plate.*]

It will not be expected, by those conversant with the inquiry, that any thing really new can be offered on a subject which has been so frequently, and so ably handled, as the inquiry into the possibility of constructing a machine which has *within itself* a principle of continued motion. There is something extremely fascinating in the pursuit of this object, as is evinced not only by the attempts of a host of tyroes in mechanics, but by the persevering efforts of some men of genius and science; who, although they have professed faith in the admitted laws of motion, have yet proved by their works that their faith was not perfect. Whilst there is nothing in the known laws which govern the material world, upon which to found the idea of being able to construct a perpetual motion, the time might not be misspent which should be devoted to an investigation of the causes which operate upon the mind, in exciting, and keeping alive, the expectation that such a machine will, some day, be discovered; but, if we possessed the ability fully to prosecute this investigation, it would belong more to a work devoted to moral than to mechanical philosophy.

Some of our readers may be ready to exclaim, 'but we have always understood that all philosophers denied the possibility of any such thing.' We believe that all who really merit the name of mechanical philosophers do unite in such a denial; but if this be the fact, the corps is but a small one; for our own observations, together with the numerous facts upon record which might be called as evidence, go to prove, most clearly, that there are but few persons who admit this truth as they admit an axiom; there appears in general to exist some mental reservation; some apprehension, that if they declare the thing impossible, it may, nevertheless, happen that some lucky wight may 'hit upon it,' and ruin their reputation as accurate philosophers.

The subject of mechanics is one which, of necessity, occupies a large portion of the attention of mankind; all the moving powers which we can command are called to our aid, but into their actual employment and adaptation, there enters much more of practice than of principle. A great proportion of our mechanics are men of observation, intelligence and experience, and many of them have paid a praiseworthy attention to science; but their very pursuits and occupations, although greatly aided by the scientific knowledge they may have acquired, forbid their carrying such investigations to a great extent; and we ought not, therefore, to be much astonished if some of them are occasionally engaged in this fruitless pursuit; to their credit, however, this is now a rare occurrence, as the obser-

* By mistake marked April.

vations founded upon a correct practice must, necessarily, lead to the same general results, as does a correct theory. The constant employment, or notice, of the various machines which are seen in daily operation, induces almost every man to conclude that he knows something of mechanics. In many of these machines the cause of their motion is very obscure, whilst the motion itself is not only evident, but so uniform and continuous, as may well lead the ordinary observer astray, and cause him to conclude, that the step from some of them, to an actual perpetual motion, is but a short one.

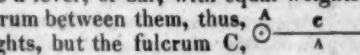
There are but few terms in our language which are less definite than the term science; it embraces almost every department of human knowledge, whether natural, moral, or physical; and it happens unfortunately, that when philosophers and men of science are mentioned, the world is not very discriminative, and the opinion of the adept in natural history, or in chemistry, will carry an undue weight on subjects to which he has not attended, and of which, although he is *a man of science*, he is nearly or completely ignorant. It is in this way certainly, and in this only, that the votaries of science, and the believers in a mechanical perpetual motion, have been identified. On which side were the scientific of Philadelphia ranged when Redheffer's machine was exhibited at Chesnut Hill? Those who recollect the period will find no difficulty in answering the question. We believe that nineteen-twentieths of those who were so esteemed were either avowed believers, or, as the politicians would say, *upon the fence.* We knew one gentleman who professed, and was believed to be, a man of great mechanical knowledge, who delayed completing a patent, lest Redheffer's machine should be found to be genuine. We are of opinion that there is scarcely any other subject so familiarly spoken of, and so little understood, as the principles of mechanics, and no one, therefore, in which quackery is more certain of success.

Let not our readers expect, although we have thus freely spoken our sentiments, that we are about to demonstrate that a mechanical perpetual motion is an impossibility; we should be willing to take any particular machine which might be pointed out to us as such, and undertake to show the fallacy of its claim; but to give a general negative demonstration is a task which we cannot undertake. It belongs to those who advocate its possibility, to establish a principle upon which it may be made to act; the general practice, however, has been, to exhibit a complication of levers, weights, or other powers, which serve to obscure the action of the individual parts, and to claim for the whole, effects to which these individual parts, taken alone, have no power to contribute.

It has been, we think truly, observed, that to produce a perpetual motion we must find a body which is, at the same time, both *heavier* and *lighter* than itself, and in which the action and re-action may consequently be *unequal.* This is, manifestly, a physical absurdity, and although many attempts have been made to cheat bodies out of the properties with which nature has endowed them, no one has had the hardihood to deprive them of their essence in a legitimate way.

To investigate the laws which obtain in the motion of bodies would require a treatise of no mean length; this, therefore, we cannot attempt, but think it necessary to offer a few remarks upon some of them, and particularly upon the property denominated *inertia*, and upon *momentum*.

The very words which we employ to designate a particular thing are frequently permitted to lead us into error, in consequence of our not restricting our terms according to the nature of the thing to which they are applied; thus we frequently use the expression, 'the power of inertia,' which may lead to the conclusion, that from this property of matter some *power* may be derived, although the very term inertia is intended to express the simple fact, that matter is altogether inactive or powerless. Inertia is a mere nullity, and, therefore, instead of conveying the idea of power, it is intended to express the entire absence, rather than the existence, of a property. If this be true, inertia can give us no aid in producing a perpetual motion, for, supposing, for the sake of argument, that gravitation, friction, and a resisting medium could be placed out of the question, as every single impulse which is given to matter tends to carry it in a right line, whatever deflected it, must necessarily abstract from, and eventually stop its motion. All our machines must have either a vibratory or a curvilinear motion, or they would, from their very structure, soon elude our grasp; any impulse which we give to them, cannot, therefore, be continued in consequence of the inertia of the matter of which they are composed. But we must also, and at every moment, encounter friction, and a resisting medium, and in consequence of these, our machine must eventually lose whatever impulse we may have given to it; for although matter is indifferent both to rest and motion, it is not so to impulse, or, which is the same thing, to resistance; and whether we abstract from its motion by grains, or by ounces, it must eventually cease. Upon this it is unnecessary to dwell, because the fact must be admitted, on all hands, to be as stated. But if inertia, or the absence of power, cannot give power to a machine, may we not obtain something from *momentum?* Momentum is the quantity of motion, and is compounded of the quantity of the matter moved, and the velocity with which it moves. The case we have been considering under the head of inertia, is a case of momentum; as we have supposed a certain impulse given to matter, which matter has in consequence acquired motion, and which motion, from inertia, would be continued were there no counteracting causes. If we give a double velocity to our machine, or mass of matter, as to a wheel for example, we give a double momentum, or what is the same thing, a double quantity of motion, and it will only require a double space of time *cæteris paribus*, to exhaust this motion; we have not, therefore, advanced a single step towards perpetuity. It consequently is not in this way that aid has been sought from momentum, but in one which, although it is equally fallacious, is better calculated to deceive. We have already observed that the momentum of a body is increased by increasing its velocity, or the space through which it

passes in a given time, although its quantity of matter remains the same. Suppose we have a lever, or bar, with equal weights at each end, supported by a fulcrum between them, thus, 

A and B are equal weights, but the fulcrum C, is but half the distance from A, at which it stands from B; when allowed to move, B will preponderate, and will move with a velocity which will be double that of A, that is, it will descend 2 inches, whilst A ascends but 1, its momentum, power, or quantity of motion, will, therefore, be double. If, now, we could cause the fulcrum to change its place from C to D, and from D to C, alternately, each of the weights would preponderate in its turn, and a perpetual vibration would ensue. How an effect of this kind has been attempted, will be seen upon an examination of some of the plans to be presented.

In many instances the machines have been made so complex, as to render an analysis of them somewhat difficult, even to well informed observers; this complexity, however, instead of promoting the desired end, only renders a larger portion of foreign aid necessary to produce and continue the motion.

Numerous impositions have been practised by individuals who have pretended that they had made self-moving machines. When deceptions of this sort have been practised, the charlatans have, of course, endeavoured to perpetuate the concealment of their mode of procedure. Most of our readers remember well the case already mentioned of Redheffer's *perpetual motion*, as it was called; the question has been frequently asked from us, whether the mode in which he made his machine to go, has ever been discovered; we believe it has not, but we could construct a machine, as did Mr. Lukens, in external appearance and motion, like his, although we still could not aver that our mode of communicating motion would be the same with his, as we have conceived of more than one mode, and he, probably, had devised another. It was easy to show that it did not move from any of the causes assigned by him, or which were visible on its exterior.

Numerous as have been the contrivances to effect a perpetual motion, but few of them are placed upon record; a circumstance which is by no means surprising, as they have always ended in disappointing the hopes of their projectors. Those who pretend to have succeeded, have not informed us how we may do so, and are, therefore, not entitled to the slightest portion of credit. Almost the only machine of the kind which has obtained any celebrity, is the wheel of Orffyreus; of which an account was published by the celebrated philosopher, S'Gravesande, in the year 1774. This machine was in the form of a large circular wheel, or drum, 12 feet in diameter, and 14 inches in depth; the whole was very light, being formed of slats of pine, the intervals between which were closed, by being covered with waxed cloth, which served to conceal the interior parts. An iron axis upon which the wheel turned, rested upon two supports. On giving to this wheel a slight impulse, in either direction, its motion was gradually accelerated, until, in a few revolutions, it acquired a velocity of twenty-five, or twenty-six turns in a minute. It was placed in a room in the dwelling of the landgrave of Hesse, the door

being locked up, and sealed with the landgrave's seal, and for two months it continued this rapid revolution; at the end of which time it was stopped, to prevent the wear of the materials. S'Gravesande was an eye-witness of the whole operation, and made a critical examination of the external parts, which resulted in a conviction on his own mind, that there was no communication with any adjoining apartments. Orffyreus pretended to be so incensed at the curiosity of S'Gravesande, that he broke the machine in pieces, and wrote upon the wall, that it was the impertinent curiosity of the professor which induced him to take this step. The prince of Hesse, who had seen the interior of the wheel, declared that after it had been in motion for a considerable space of time, there was no appearance of any change in its parts; that there were no pieces which indicated fraud or deception, and that its construction was very simple. Orffyreus could never be prevailed upon to construct another.

This is all the information which we possess respecting this celebrated wheel, and it appears useless to offer any conjecture respecting the manner in which it was moved. It is highly probable, however, that the time had arrived when it suited Orffyreus to destroy it, to prevent detection and preserve his secret. When Redheffer had exhibited his machine for as great a length of time as he deemed it safe to do, he had it packed up for the purpose of sending it to Europe, in the care of two gentlemen with whom he had formed a connexion, and who were confident that it was a genuine self-moving machine. The war then existing prevented its being shipped; the principal of the two gentlemen alluded to, opened the case, and put the machine together, without the knowledge of Mr. Redheffer, when, lo, he found, to his utter astonishment, that the principle of motion had become extinct, and that the causes which had appeared to him sufficient to give it action, had, in reality, nothing to do with it. Mr. Redheffer was so incensed at the "impertinent curiosity" of the gentleman, who dared to open it before its arrival in Europe, that he refused to have any thing further to do with it. We apprehend that there is considerable parallelism between these two cases.

We have already made some remarks upon the preponderance of one end of a lever which has equal weights at each end, when the fulcrum is nearer to one end than to the other. Most persons are theoretically or practically acquainted with this fact, which depends upon a fundamental property of the lever; but it requires more knowledge, and a greater power of abstraction and analysis than most persons possess, to reduce a compound apparatus into its elements, particularly when its parts are constantly changing their relative positions, and their mutual actions are, consequently, varied. It may appear apposite to introduce, in this place, a description of the apparatus contrived by Desaguliers, in which two equal weights may be placed at any distance whatever from the centre of motion, and still continue in equilibrio. Fig. 1, in the plate, represents this instrument, A D denotes a balance with equal arms, and E F another of the same dimensions. These move on the centre B and C, and are connected by the inflexible rods A E and D F; the motion being left

free by means of joints at the corners. Across the rods A D, E F, are fixed two bars I K, L M. Now it is unnecessary to show that the weight G, will describe exactly the same line or circular arc, when the levers are moved into the position *a d f e*, or any other position, as it would have described in case it had been suspended at A, or K, or E; and that it is of no consequence in this respect at what part of the line A E, or I K, it be fixed. The same observations are true of the weight H, on the other side, and, accordingly, it is found, that these equal weights may be suspended any where on the lines I K, and L M, without altering their equilibrium.

By this contrivance, it is most evidently proved, to those who are totally unacquainted with the theory, that weights do not preponderate in compound engines, on account of their distance from the centre; and yet it is evident, upon a little reflection, that the fundamental proposition of the lever, or balance, remains uncontradicted; this proposition is, that equal bodies, at an equal distance from the fulcrum, will equipreponderate, but that at unequal distances, the most remote will descend.

Fig. 2. represents the most common form in which it has been attempted to make a self-acting machine. Hundreds, and probably thousands of models, have been made upon this plan, several have come under our own inspection, and, indeed, it appears to be the general stepping stone of those who begin the pursuit. We do not know that there is any earlier record of this plan, than that contained in the celebrated Bishop Wilkins's *Mathematical Magic*, published in the year 1684, although its antiquity, we have no doubt, is much greater. It is represented in that work, with sixteen loaded arms, but for the sake of simplicity, six only have been retained in the present drawing. Each lever, A, B, C, D, E, F, is moveable through an angle of 45°, by a joint near the circumference of the wheel, and the inner end or tail of each is confined by two studs or pins, so that it must either lie in the direction of a radius, or else in the required position of obliquity. If the wheel be now supposed to move in the direction E F, it is evident that the levers A, B, C, D, by hanging in the oblique position against the antecedent pins, will describe a less circle in the ascent, than when on the other side they come to descend in the positions E F; hence it was expected that the descending weights, having the advantage of a longer lever, would always preponderate. Dr. Wilkins, by referring the weights to a horizontal diameter, has, in this machine, shown that they will not. A popular notion of this result may also be gathered from the figure, where there are three weights on the ascending, and only two on the descending side; the obliquity of position on one side giving an advantage in point of number, equal to what the other may possess in intensity. Or if this contrivance were to be strictly examined, on the supposition that the levers and weights were indefinitely numerous, the question would be determined by showing that the circular arcs A K, H I, are in equilibrio with the arcs A G, G L.

The simplest method of examining any scheme of this kind with weights, consists in inquiring whether the perpendicular ascents and

descents would be performed with equal masses in equal times. If so, there will be no preponderance, and, consequently, no motion. This is clearly the case with the contrivance before us.

The marquis of Worcester, who will ever be remembered as the inventor of the steam engine, has described a perpetual motion in the 56th number of his Century of Inventions, published in the year 1655, and reprinted in this journal, Vol. 3d, p. 374. His words were as follow:

"To provide and make, that all the weights of the descending side of a wheel shall be perpetually further from the centre than those of the mounting side, and yet equal in number and heft to the one side as the other. A most incredible thing if not seen, but tried before the late king (of blessed memory) in the tower by my directions, two extraordinary ambassadors accompanying his majesty, and the Duke of Richmond and Duke Hamilton, with most of the court attending him. The wheel was 14 feet over, and 40 weights of 50 pounds a piece. Sir William Balfour, then lieutenant of the Tower, can justify it with several others. They all saw, that no sooner these great weights passed the diameter line of the lower side, but they hung a foot further from the centre; nor no sooner passed the diameter line of the upper side, but they hung a foot nearer. Be pleased to judge the consequence."

Desaguliers, in his course of experimental philosophy, Vol. 1, p. 185, has quoted this passage, and given a sketch of a pretended self-moving wheel, similar to that of Fig. 3, as resembling the contrivance mentioned by the marquis of Worcester. The description of the last engineer agrees, however, somewhat better with the contrivance Fig. 2. It must, of course, be a mistake in terms, when he says the weight receded from the centre at the lower diameter, and approached towards it at the upper: the contrary being, in fact, necessary to afford any hope of success; and, accordingly, in the quotation it is so stated.

Mr. Nicholson is of opinion, that the wheel of Orffyreus was constructed in the manner represented in Fig. 3, and that it, probably, was made to revolve, during the time of exhibition, by some concealed apparatus. This represents a number of cells or partitions, distinguished by the letters of the alphabet, which are made between the interior and exterior surfaces of two concentric cylinders. The partitions being placed obliquely with respect to the radius, and a cylindrical or spherical weight placed on each, it is seen from the figure, that these weights will lie against the inner surface of the large cylinder, whenever the outer end of the bottom partition of any cell is lowest; and on the contrary, when that extremity is highest, the weight will rest on the surface of the interior cylinder. Let the wheel be made to revolve in the direction A, B, C; the weights in C, D, E, F, G, H, I, being close to the external circle, and the weights K, L, M, A, B, close to the inner, for the reasons last mentioned. As the cell B descends, its weight will likewise run out, at the same time that the weight in the cell I will run in, in consequence of its partition being elevated. By the continuation of this process, since

all the weights on the descending side pass down at a greater distance from the centre, while those on the ascending side rise for a considerable part of their ascent at a less distance from the same point, it is concluded that the wheel will continue to retain its motion. On this, however, it is to be remarked, that the perpendicular ascent and descent are alike, both in measure, and in time of performance, and that the familiar examination, even to those who know little of such subjects, is sufficient to show that the preponderance is not quite so palpable as it at first appears. For the weights G and F, H and E, I and D, are evidently in equilibrio, because at the same horizontal distance from the centre; and if the favourable supposition that the weight B has already run out, be admitted, it will then remain a question whether these two exterior weights, B and C, can preponderate over the four inner weights K, L, M, A. The more accurate examination of this particular contrivance, will lead to the following theorem. In two concentric circles, if tangents be drawn at the extreme points of a diameter of the smaller, and continued till they intersect the larger, the common centre of gravity of the arc of the greater circle included between the tangents, and of the half periphery of the smaller circle on the opposite side of the diameter, will be the common centre of the circles.

If, therefore, the balls were indefinitely numerous and small, the supposed effective part of the wheel, Fig. 3, would be in equilibrio, as well as the parts beneath the horizontal tangent of the inner circle.

Fig. 4, represents a small wheel, or hollow ring, with hollow projecting spokes, into which a quantity of quicksilver is poured. Small bellows are fixed on the end of each spoke, so that the mercury may run into them, through the tube; the moveable board of each bellows has a weight attached to it, as seen in the drawing. The weights on the ascending side operate to close, and those on the descending side to open the bellows; it is thus intended to force the mercury from the former into the latter. There is no difficulty whatever, in perceiving that we have here only substituted a fluid for the balls and weights in Figs. 2 and 3, and the same theoretical objections will apply in each case.

Fig. 5 is the plan of a machine for which a patent was obtained by Dr. Shivers, in England, in the year 1790, and which, it was pretended, continued in motion for several months together. There, however, is not the smallest probability that it would continue in motion for half a minute, or nearly as long as a simple wheel would retain part of its first impulse.

In the drawing of this machine, the external circle denotes a wheel carrying a number of buckets, A, B, I, L, &c. C represents a toothed wheel, on the same axis, which drives a pinion D; and this last drives another pinion E upon the axis of a lanthorn, or wheel intended to work a chain pump with the same number of buckets as in the large wheel A, B, I. The lanthorn G, is made of such a size as to raise the buckets *a*, *b*, *i*, *l*, with a due velocity. K represents a gutter, through which a metallic ball, contained in the bucket *m*, may run and lodge itself in the bucket A of the wheel. Each of the buckets of the wheel B, I, L, M, which are below the gutter, is sup-

plied with a metallic ball, and so, likewise, are the ascending buckets *a*, *b*, *i*, *l*, *m* of the chain-pump. As the pump supplies the wheel, it is itself again supplied at M, where the balls fall into its ascending buckets. Now, it is presumed, that the balls in the wheel, I suppose on account of their distance from the centre of motion, will descend with more than sufficient force to raise those on the chain, and, consequently, that the motion will be perpetual.

The deception in this contrivance, has much less seduction than in either of the three preceding, because it is more easily referred to the simple lever. It may readily be seen by those who have any knowledge of mechanics, and particularly of wheel work, that whatever is gained by the excess of the diameter of the great wheel, beyond that of the wheel C, is again lost by the excess of the lanthorn G beyond the pinion E.

A large portion of the foregoing description has been taken from an article on the same subject in the quarto series of Nicholson's journal, as it appeared well calculated for our purpose. Some portions of it we should have attempted to render more familiar, had not other avocations interfered.

The simplest rule that we can give, by which to perceive the fallacy of every plan depending upon the ascent and descent of weights, is, that whatever may be the weight which descends in a given time, it must raise an equal portion of matter to the same perpendicular height, in the same time, or the machine must evidently stop; now the power required to raise any weight to a given height is the same, provided the time be the same, whether that weight be raised vertically, or obliquely. If the weights, the balls, or the mercury are to descend, they must first ascend to the necessary height; an equilibrium must, therefore, soon take place, should motion be produced by any extraneous force. Putting friction and a resisting medium out of the question, these machines supply no source of motion even to themselves.

It is not intended to be denied, that there are in nature, agents, or powers, which we may employ to keep machines of various kinds in constant action, whilst the materials of which they are composed, will endure; but this would not constitute a mechanical perpetual motion; according to our understanding of the term, the motion must be produced by an unvarying energy in matter, resulting from its inherent properties, such as its gravity. Not only is the whole system of the universe in motion, but upon the surface of our earth the various particles of which its materials are composed, are perpetually moving amongst themselves; some of these motions are perceived by their effects, only after a considerable lapse of time, or by the aid of delicate instruments; whilst others are readily perceived by the senses, in consequence of the rapidity with which they are effected. Some of these may be employed to keep clocks, and other engines wound up so that their action shall be continued. The contractions and expansions of a long bar of metal, from changes of temperature, the rise and fall of mercury in the barometer, the perpetual current of rivers, the flux and reflux of the tide, regular and irregular winds,

Fig.5.

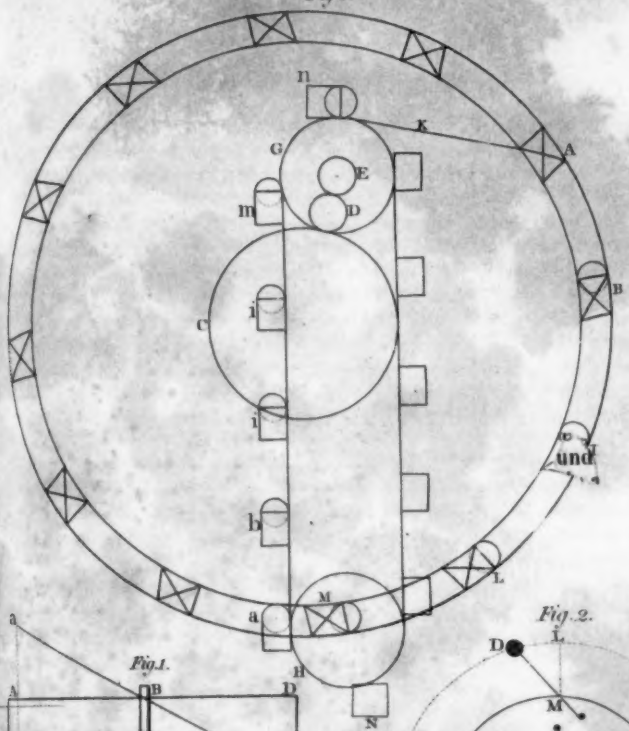


Fig.1.

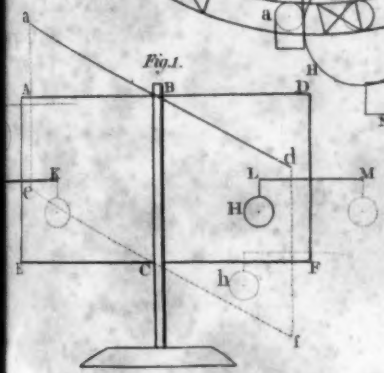


Fig.2.

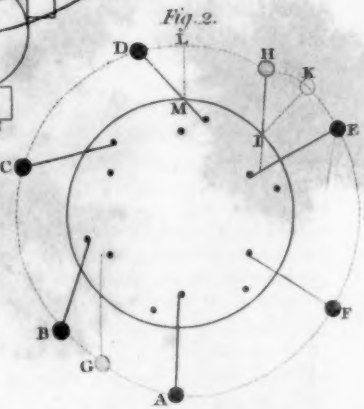


Fig.4.

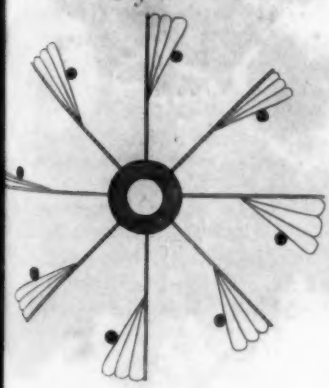
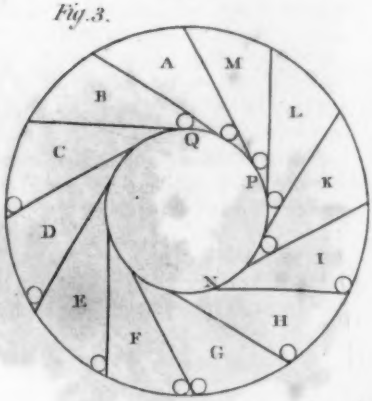


Fig.3.



and drafts, or currents of air, the hygrometric changes in certain substances, are of the kind intended; the employment of some of them is familiar, and the possibility of using the whole of them, as well as some others which have not been enumerated, will be evident to most of our readers.

The galvanic action produced by the contact of certain bodies, as in the electrical columns of Zamboni, De Luc, and others, has, for several successive years, kept a pendulous body in vibration, so as to strike bells, and cause them to ring; and we think it highly probable that means may yet be discovered for obtaining a similar action from the magnetic influence. The intimate connexion between heat, light, electricity, and magnetism, which has been pointed out by the novel and curious discoveries on *electro-magnetism*, serves to give additional probability to such a conjecture; but should we succeed in the development and direction of these powers with undiminished energy, so as to produce a continued and sensible motion in any body, or system of bodies, we should be no nearer to the solution of the problem of a mechanical perpetual motion, than we are at present; and it would require no small degree of hardihood in any one to assert that we have yet advanced a single step in the inquiry, by all the labour and thought which numerous ingenious individuals have given to the subject.

On the blowing of Air into Furnaces, by a Fall of Water. *By the late* William Lewis, M. D.

(Concluded from page 80.)

I have received an account from a worthy correspondent in Switzerland, of a machine which he has constructed for a smelting furnace according to the foregoing directions: he says, it has so much the advantage of all other kinds of bellows, that it deserves to be introduced universally wherever the situation of the place will permit. The only inconvenience he finds in it is, that the colander and gratings are liable to be stopped up with leaves, &c. With regard to the colander, the obstruction may be obviated by enlarging the holes. The gratings ought to be of a large surface: the wire grating in the cistern on the top may be a cylinder, nearly as large as the cistern will receive, for if it is no more than sufficient to cover the mouth of the pipe, it will doubtless be found choked up. When so much of the cylinder becomes stopped, that the water has no longer a free passage through, it may be lifted up and cleaned, another being placed in the room of it, without the trouble of turning off the water, or interrupting the going of the machine. The gratings here can be liable to no other inconveniences than those which are common in other water-machines, mills, aqueducts, &c.

Some further improvements have occurred in the construction of these machines, by which they may be made effectual, in cases when the quantity of fall of water would otherwise be insufficient.

Of constructing Blowing-Machines, with Falls of Water of great height.

Where the height of the fall is great, the quantity of water is usually small; and in all the ways of application that have hitherto been contrived, the height will by no means make amends for the deficiency in quantity.

In the common construction of these machines, where the upper pipe, or funnel, is no more than three, four, or five feet high; though the fall should be such as to admit of the lower pipe being thirty or forty feet or more, it does not appear that any material advantages could result from such a height. For, as the air is admitted into the water only at the top of this long pipe, it cannot, I think, be supposed that the quantity admitted will be the greater for the length of the passage under the place of its admission. Water indeed has been found by Marriotte to run faster through an upright long pipe than through a short one: a quantity of water which was forty-five seconds in running through a pipe three feet long, was discharged in thirty-seven seconds, or near a sixth part less time, through a pipe of the same bore, and a double length; so that, as more water passes successively through a long pipe than through a short one, in equal times, more air also must be carried down by it. But in the case which we are here considering, no benefit can be expected on this principle; for as the supply of water is supposed to be limited, the bore of the pipe must necessarily be made less, in proportion to the increase which its length may produce in the velocity. If the lower pipe is of such a height that the watery column it contains may sufficiently resist the force of the air in the air-vessel, it should seem that any further addition to its height could be of no manner of use.

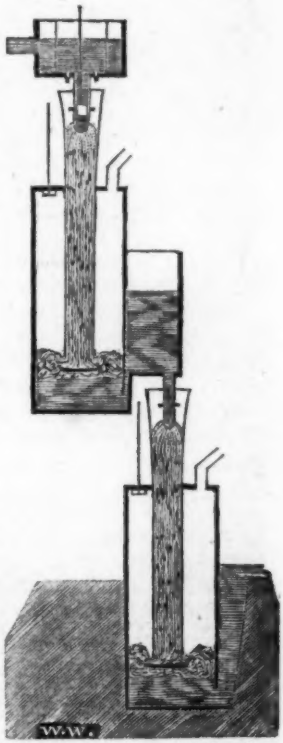
We have seen, in the foregoing part of this essay, that it would be more adviseable in such cases to shorten the lower pipe, and to lengthen the upper one: by this means the water, acquiring greater velocity at the place of its discharge from the upper pipe into the lower, is enabled to divide or spread more, and thus to receive more air into its interstices. The advantage thus obtained does not, however, increase in so great a proportion as the height does. From an experiment above related, it appears, that by increasing the height four-fold, the effect was not increased three-fold; and this even in small heights, where the effect is much more influenced by a variation in height than it is in great ones.

The observations already mentioned, point out the means of availing ourselves more advantageously of high falls, so as to produce always, with certainty, from a fall of a double or treble height, a double or treble effect, if the quantity of water be the same; or an equal effect, with one-half, or one-third, the quantity of water.

Experiments have convinced me that a fall of fourteen feet is more than sufficient for compressing the air to such a degree as to be able to sustain the gauge to the height of four feet; or to raise, on an opening of a square inch, a weight of about a pound and three-quarters avoirdupois, or above two pounds troy; a compressure which is

apprehended to be as great as there will in general be occasion for. Where we have plenty of water with such a fall, we can drive in air, with this force, in any quantity: for if one machine, with a certain portion of the stream, produces a continued blast of this strength, through a pipe of a certain bore, as an inch, or three-quarters of an inch, it is evident that the quantity of air may be doubled, trebled, &c. at pleasure, without diminishing the compressure or force of the blast, by adding another and another machine, till all the stream is employed. It is plain, in like manner, that the same advantage may be received from high falls, by placing one machine over another; that after the water has performed its office in falling through one machine, it is still capable of exerting the same action in another and another machine, so long as equal spaces remain for it to fall through; so that the total effect must be the same as if a quantity of water, sufficient for working all the machines, came at first in one stream.

Fig. 1.



A natural fall of water of twenty-eight feet, formed into two artificial ones of eighteen feet each, is represented in Fig. 1. This double machine may be presumed to have twice the effect of a single one, in virtue of this division; besides the advantage of the more free admission of air, and the spreading of the stream through a pipe of a much larger bore, by which it is enabled to carry down in its interstices a much greater quantity of air. The two vertical lines in the upper reservoir represent a cylindrical grating of iron wire, to keep back weeds, &c. The division of the air-vessel, and the course of the water from the upper machine to the lower, are apparent from the figure.

In the lower machine, whose air-vessel is sunk to a considerable depth in a pit made in the ground, the water is forced up in the pit, on the outside of the vessel, four feet higher than the surface of the water within the vessel, or of the stone on which the water dashes, called by the workmen the dash-board. The air-vessel of the upper machine having an additional part at one side, which performs the same office as the pit, the water is in like manner forced up to the same height in this outer part; which outer part serving as a reservoir for the machine under it, the water begins to act in this lower machine four feet higher up than the dash-board of the first. Whatever number of machines the fall will admit of,

the case is the same in them all: though in each of them the water falls eighteen feet, yet as it is pressed up again four feet for the succeeding machine, one machine takes up but fourteen of the real fall.

The outer vessel, and its communication with the air-vessel, may be conveniently formed by an upright partition in the air-vessel itself not reaching quite to the bottom. The outer division may be open at top, and need not be so high as the close air-vessel; it is fully sufficient if it reaches a little more than four feet above the level of the dash-board, the water which it is designed to receive not rising higher than this. In other respects, the structure of these machines agrees entirely with that of the single ones already described. It must be observed only, that the colanders of the lower machines should be, as nearly as possible, of the same dimensions with those of the upper ones. For if they are of smaller bores, they will not admit of all the water which passes through the upper ones, so that part of it must run to waste; if they are larger, the water will pass off too fast, without producing its due effect. The regulators before described are here particularly useful, affording ready means of increasing or diminishing the apertures in the colanders occasionally while the machines are at work.

Fig. 2.

Fig. 2 is a prospective view of the colander, screwed to the upper pipe, drawn to a larger scale, to show the disposition of the holes. The holes may be made wider than formerly proposed, as an inch each side, to prevent any danger of their being choked up.

Of Blowing Machines, with low falls of Water.

The dimensions hitherto given are such as appear the most advantageous. Much lower falls, however, than those which the foregoing machines are calculated for, as ten, eight, or perhaps seven feet, may be made to afford a strong blast. To produce such a compressure of the air in the air-vessel, as to raise the gauge four feet, a fall of about six feet is necessary for the lower pipe. If the upper pipe is only about a foot and a half or two feet, the water, when divided by means of the colander, will carry down a certain quantity of air; and though the quantity, from an equal stream of water, will not be so great as when the fall is higher, yet, as there are in many parts of the kingdom large bodies of water running with such a descent, the deficiency may be compensated, as already noticed, by enlarging or multiplying the machines.

For many purposes, still less falls will suffice. The smith's bellows, as we have formerly seen, raises the gauge only about fourteen inches; and such a compressure, it is presumed, may be gained from a fall of five feet or less. Small falls may be applied also to another purpose, of no little importance, *the ventilation of mines and coal-pits*, or the driving in of fresh air, in the room of that which the mineral vapours have rendered unwholesome or pernicious.

In all these machines, it must be observed, that the height of the column of water falling through the pipe, determines not the actual force of the blast, but the greatest force which can be given it in that machine: that the height of the gauge is always the measure of the actual force; that this force depends on the width of the pipe through which the air is discharged from the air-vessel, and may be diminished or increased in any degree up to the greatest that the column of water can resist, by widening or narrowing the aperture of the pipe; that different machines will give blasts of equal force through pipes of greater or less width, according to the greater or lesser quantities of air which the water carries down with it; and that, therefore, the size of the blast-pipe must be adjusted by trial, for each particular machine.

The distance of the dash-board under the pipe may likewise admit of some variation, and require to be regulated according to the size of the pipe. In some of the common machines this distance is three or four feet, or more; but so large a space is apparently a disadvantage; for so much of it as is more than sufficient for the free passing off the water is entirely useless, being, in effect, so much taken off from the height of the fall. The distance of six inches, laid down in the foregoing machines, is designed for a circular pipe of twelve inches diameter; in which case the area, by which the water is discharged all round, is just double to the area of the pipe, and consequently more than large enough for letting the water off without impediment.

AMERICAN PATENTS.

Numerous applications are made at the Patent Office for information respecting the mode of taking out patents, and the tenure by which they are held; to answer these inquiries the subjoined directions have been drawn up, and printed for distribution. The points which have been noticed, are those to which these inquiries ordinarily relate; and it will be seen by those who have been attentive readers of this Journal, that for much of the information given, the editor is indebted to the essays on the patent laws, written by his friend P. A. Browne, Esq.; it is indeed from an attentive study of these excellent essays, that he has derived a large portion of the knowledge which he possesses of the actual operation of the patent laws of this country, and of England.

Information to Persons applying for Patents, or transacting other business at the Patent Office.

DEPARTMENT OF STATE—PATENT OFFICE.

The Acts of Congress which relate particularly to the granting of Patents for inventions and improvements, are two in number; the first was passed February 21st, 1793; and the second, on the 17th of April, 1800.

The persons who have a right to take out patents, are all citizens of the United States; and aliens who have resided therein for two years. In other cases they can be obtained only by a special act of the national legislature.

Joint inventors may take out a joint patent, and where two or more persons have concurred in perfecting any invention or discovery, it would seem necessary that they should also concur in taking out a patent, as neither of them can justly claim to be the sole inventor.

In case of the decease of an inventor, who has not taken out a patent for his invention, it may be obtained by "the legal representatives of such person, in trust for the heirs at law of the deceased, in case he shall have died intestate; but if otherwise, then in trust for his devisees." "And when application for a patent shall be made by such legal representatives, the oath, or affirmation," &c. "shall be so varied as to be applicable to them." (Act of 1800, sec. 2.)

The term for which a patent is granted, is fourteen years: a patent cannot be renewed at the expiration of this term, excepting by a special act of Congress.

The things for which a patent may be obtained, are, "any new and useful art, machine, manufacture, or composition of matter, or any new and useful improvement on any art, machine, manufacture, or composition of matter, not known or used before the application." (Act of 1793, sec. 1.)

The thing patented must be new. "Every inventor before he can receive a patent, shall swear, or affirm, that he does verily believe that he is the true inventor, or discoverer of the art, machine, or improvement, for which he solicits a patent." (Act of 1793, sec. 3.) In the case of a resident alien, it is required, that he declare on oath, or affirmation, in addition to what is required from a citizen, "that the same hath not, to the best of his or her knowledge or belief, *been known or used in this or in any foreign country.*" (Act of 1800, sec. 1.) It thus appears that an alien is restricted from taking out a patent although he may be "the true and original inventor or discoverer," provided the thing has "been known, or used, in this or any foreign country."

ON THE FORMS, AND MANNER OF PROCEDURE, NECESSARY IN APPLYING FOR A PATENT.

The method of applying for a patent is by petition, addressed to the Secretary of State, which is usually in the following form:

To A. B. Secretary of State of the United States:

The petition of C. D. of ———, in the county of ———, and state of ———, respectfully represents—

That your petitioner has invented a new and useful improvement in [the machine for cutting and heading nails at one operation,] *which has not been heretofore used or known, the advantages of which he is desirous of securing to himself and his legal representatives; he therefore prays that letters patent of the United States may be issued, granting unto your petitioner, his heirs, administrators, or assigns, the full and exclusive right of making, constructing, using, and vending to others to be used, his said improvement* (art, invention, machine, manufacture, or composition of matter, etc.) *agreeably to the acts of Congress in such case made and provided; your petitioner having paid thirty dollars into the treasury of the United States, and complied with other provisions of the said acts.*

C. D.

THE DESCRIPTION OR SPECIFICATION.

Accompanying the petition there must be a description, or, as it is usually termed, a specification of the thing intended to be patented; the words of the law are as follows, "and shall deliver a written description of his invention, and of the manner of using, or process of compounding the same, in such full, clear, and exact terms, as to distinguish the same from all other things before known, and to enable any person skilled in the art or science of which it is a branch, or with which it is most nearly connected, to make, compound, and use the same. And in the case of any machine, he shall fully explain the principle, and the several modes in which he has contemplated the application of that principle, or character, by which it may be distinguished from other inventions." (Act of 1793, sec. 3.)

The following form may be used for the preamble of the description, or specification:

To all to whom these presents shall come:

Be it known, that I, C. D. of ———, in the county of ———, and state of ———, have invented a new and useful improvement in [the machine for cutting and heading nails at one operation,] *and that the following is a full and exact description of the construction and operation of the said machine, as invented or improved by me.*

Here follows the description of "the art, machine, manufacture, or composition of matter." It is scarcely necessary to observe, that the phraseology of the specification must be such as to correspond with the nature of the thing patented, whether it be an *art, machine, or composition of matter;* by which last term is intended, what is usually called a *compound*, the recipe for which is to be given in the specification.

The necessity of the most particular attention to the requirements of the law, in drawing up the specification, cannot be too forcibly urged upon those who apply for patents. A number of those which have

undergone judicial investigation, have been vacated in consequence of some defect in the matter or form of this instrument: it is, in fact, upon the averments of the specification that the validity of the patent must, in almost every instance, be decided. Many specifications which are deposited in this office, evince not only an ignorance of the laws regulating the granting of patents, and the decisions which have taken place under them, but also manifest a deficiency of that knowledge in mechanics, and the arts, which is necessary to an accurate and clear description of a machine, or process, and without which a patent must be evidently insecure; all that can be now offered, are a few directions embracing those points which appear to be of the most importance.

A patent is to be considered as a contract between the patentee, and the public: the former is to make known in *full, clear, and exact* terms, the nature of his invention, or discovery, so as to enable a person skilled in the art, to practise it, from this description: the latter, on condition of this being done, secures to the patentee, the exclusive right to use and dispose of his invention or discovery, for the term of fourteen years, in consideration of which it is afterwards to become public property. The necessity, therefore, of observing the following rules will be apparent.

In making the description, no part of the invention may be omitted, the whole must be described.

The whole process is to be made known; a less perfect mode of proceeding must not be inserted whilst a more perfect one is known to, and practised by, the patentee.

It is not sufficient, that the whole machine, process, or compound be given; if there be added any part, or ingredient, calculated to defeat the process, and intended to deceive the public, the patent is not good.

No more must be claimed in the patent, than what is new, and is the invention, or discovery, of the patentee.

Many patents have been vacated, in consequence of inattention to this last rule. In the specification it is perfectly proper to describe an entire machine, although most parts of it may have been long known and used, as, otherwise, it may be difficult to make known the improvements; but after doing this, the patentee should distinctly set forth what he claims as new; and this is best done in a separate paragraph, at the end of the specification; which may commence in a form something like the following:

What I claim as new, and as my own invention or discovery, in the above described machine, [art, manufacture, or composition of matter,] *and for the use of which I ask an exclusive privilege, is, &c. &c.*

Where the machine or instrument is old, but is applied to an entirely new purpose, this fact must be stated; as the patent in this case cannot be for the instrument, but must be for the application of it only.

Where a patent is taken for an improvement upon a machine previously patented by some other person, the right to use the original

invention must be obtained from the first patentee; nor can he use the improvement without the consent of the improver.

"*And be it further enacted*, That any person who shall have discovered an improvement in the principle of any machine, or in the process of any composition of matter, which shall have been patented, and shall have obtained a patent for such improvement, he shall not be at liberty to make use of, or vend, the original discovery, nor shall the first inventor be at liberty to use the improvement: and it is hereby enacted and declared, that simply changing the form or proportions of any machine, or composition of matter, in any degree, shall not be deemed a discovery." (Act of 1793, sec. 2.)

When an inventor obtains a patent for an improvement upon an article previously patented by himself, the right to the first article, (a machine for example) will become public at the end of the term for which the first patent was taken. The improvement cannot have the effect of renewing the original grant.

The specification must be signed by the applicant, in the presence of two subscribing witnesses.

OF THE OATH OR AFFIRMATION.

Subjoined to the specification, there must be an oath, or affirmation, administered by some duly qualified person. This, when the applicant is a citizen, may be in the following form:

County of ———, } *ss.*
State of ———, }

On this ——— *day of* ———, 18—, *before the subscriber, a justice of the peace, in and for the said county, personally appeared the aforenamed C. D. and made solemn oath* [or affirmation] *according to law, that he verily believes himself to be the true and original inventor, or discoverer, of the machine* (art, invention, or improvement, composition of matter, etc.) *above specified and described for* [cutting and heading nails at one operation;] *and that he is a citizen of the United States.*

——— ———, *Just. Peace.*

If not a citizen (or citizens,) to the oath or affirmation that he verily believes himself to be the true and original inventor or discoverer of the machine, etc., the following addition must be made; "*and that the same hath not, to the best of his* [or her] *knowledge or belief, been known or used either in this or in any foreign country: and that he* [or she] *hath resided in the United States for two years.*"

Every application for a patent will thus consist of three distinct instruments of writing: the petition, the specification, and the oath, or affirmation. The petition ought to state in clear, but concise terms, the nature, or object of the improvement, &c. for which a patent is claimed; in the specification the invention or discovery should be fully and completely described; and this, in its words and tenor, should agree with the object concisely stated in the petition; and the oath or affirmation ought also to correspond with the preceding instruments.

OF DRAWINGS, MODELS, AND SPECIMENS OF INGREDIENTS.

The law declares that the patentee "shall accompany the whole with drawings, and written references, where the nature of the case admits of drawings." (Act of 1793, sec. 3.) Great difficulty has been sometimes experienced in preparing specifications, from a prevailing idea, that it is necessary to describe a machine *in words*, without any reference being made to the drawing, in the body of the instrument. Neither the words of the law, or the practice of the office, lend any aid to this opinion. References to the drawing may be made throughout, and in most instances the description may be much shortened by so doing; observing that whenever references to the drawings are made in the specification, two copies of these drawings must be forwarded, one of which will be returned, attached to the patent, and the other retained in this office.

The drawings ought, in general, to be in perspective; and these should be accompanied by representations in section, or in detail, of such parts as may not otherwise be clearly understood.

They should be well executed, and rarely need exceed the size of a page of letter paper.

A model will, hereafter, be required in all cases where it is believed that the nature of the machine will be more clearly shown by it, than by drawings alone. The law says, "and such inventor shall moreover deliver a model of his machine, provided the Secretary shall deem such model to be necessary." (Act of 1793, sec. 3.) These models should be neatly made, and as small as a distinct representation will admit; they ought to have a permanent label affixed to them, by engraving, painting, or otherwise. They will be carefully kept, for the advantage of the patentee, and the information of the public.

When the invention is a *composition of matter*, the law requires that specimens of the ingredients shall be deposited: the words are, "or with specimens of the ingredients, and of the composition of matter, sufficient in quantity for the purpose of experiment, where the invention is a composition of matter." (Act of 1793, sec. 3.)

OF INTERFERING APPLICATIONS.

Requests are frequently sent to this office, that patents may not be granted, or that, in certain cases, they may be delayed; these requests are founded in a very prevailing, but erroneous opinion, that there is such a judicial or discretionary power, vested in this department. In the United States, the patent is a *constitutional right*, which the citizen, or the qualified alien, may demand, and which the officers of government have no power to withhold. Should a patent issue to an individual to-day, another person who shall have complied with all the requirements of the law, may to-morrow, obtain a patent for the same thing. The validity, in either case, is a question for a court and jury to decide. The patent secures to the patentee, the exclusive right to *his own* invention, or discovery; but it confers no right to the thing patented, where he is unable to sus-

tain the allegation, "that he has invented a *new* and *useful* art, machine, manufacture, or composition of matter;" "or a *new* and *useful* improvement," &c. (Act of 1793, sec. 1.)

When there are two applicants at the same time, for a similar patent, the law has provided for the appointment of three arbitrators, one by each party, and one by the Secretary of State. Where there are more than two applicants, and they do not concur in the appointment of arbitrators, the whole may be appointed by the Secretary of State, and their award is "final as respects the granting of the patent." (Act of 1793, sec. 9.) This, however, does not render the patent valid, as the question of its validity may afterwards be examined in a court of law.

In order to justify a reference, it has been determined, that each party must have complied with all the legal requirements; that is, they must each have paid thirty dollars into the treasury, and their papers have been regularly filed. As this rarely occurs, the remedy sought, is, in general, that pointed out in the 10th sec. of the Act of 1793, which provides, that "within three years after issuing the patent, upon an oath or affirmation being made before the judge of the district court, where the patentee, his executors, administrators, or assigns, reside, that the patent was obtained *surreptitiously*, or upon *false suggestion*, the court, upon motion made, if the matter alleged appears to be sufficient, may grant rule to show cause why process shall not issue to repeal the patent."

FEES PAYABLE IN THE PATENT OFFICE.

The first step, in applying for a patent, is the payment of thirty dollars; "every inventor, before he presents his petition to the Secretary of State, signifying his desire of obtaining a patent, shall pay into the Treasury, $30, and the money thus paid shall be in full for the sundry services to be performed in the Office of the Secretary of State." (Sec. 11, Law of 1793.)

For copies of patents, or parts thereof, there is a charge of 20 cents for every 100 words; and the legal allowance for copying a drawing, is $2. The actual charge is frequently less than this, but in many instances, the drawings are so complex that they cannot be executed for this sum.

The average expense of recording a transfer is about one dollar; the fees being the same as for copies of patents.

For certified copies of patents there is an extra charge of 25 cents, but these are furnished in litigated cases only, to be used as evidence. All payments must be made previously to the delivery of the papers to the applicant.

OF A CAVEAT.

Caveats are not known in law. There is a prevalent, but erroneous idea, that a *caveat* may be entered, which will secure the right for a certain time. It is the practice of the Office to put on file, such accounts of inventions or discoveries, as may be forwarded for that purpose;—these are not exhibited to others, but may be used as evidence when required by the depositor. It is also the practice to

inform him, should a similar application be made. This, however, is not to be expected, excepting in recent cases, as such descriptions are not recorded, and the number on file renders a general examination impracticable.

TRANSFER OF A PATENTEE'S RIGHT.

An inventor may transfer his right before a patent has issued, and the assignee may take out a patent; or he may obtain his patent, and afterwards assign it. The assignment, in either case, must be recorded in the Patent Office. (Act of 1793, sec. 4.)

Those applicants for patents who are desirous of having them issue immediately, may have this done by sending on two complete sets of papers, neatly written; in this case, one copy of the specification should be upon parchment, of the size of foolscap paper, opened out; or it may be written upon such paper, of a strong texture.

All communications to, and from, the Superintendent of the Patent Office are free of postage; the petition to the Secretary of State; the fees to be paid into the Treasury; and all other matters on the subject of patents, may be addressed, directly, to this office; and all business relating to patents, may, in general, be as well done by writing, as by a journey to Washington.

When models are demanded, a reasonable time for forwarding them, is allowed to applicants who live in remote situations, and the patent is issued, upon a bond being given providing that the model shall be delivered at the office within a time specified.

Those who are unable to obtain good drawings at home, may have them executed at Washington, by persons unconnected with the office. In some cases, a rough sketch, and in all, a good model, will serve as a guide. Care will be taken that the charges shall be moderate. THOMAS P. JONES, *Superintendent.*

LIST OF AMERICAN PATENTS GRANTED IN SEPTEMBER, 1828.

With Remarks and Exemplifications by the Editor.

1. Improvement in the construction, manufacture, and management of the *Bobbins and Flyers for spinning cotton;* Charles Danforth, Ramapo, Rockland county, New York, September 2.

As soon as some anticipated improvements are completed, the whole will be presented to our readers. The patentee does not yet consider his system as perfect, and, therefore, wishes the publication delayed.

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2. Improved machine for *Washing all kinds of wearing ap-*

parel, &c.; Jonathan R. Davis, Hartland, Niagara county, New York, September 2.

This machine has a wash-board, very similar to that which has been so extensively used in this country, having grooves across it, upon which the clothes are rubbed by hand, instead of being rubbed between the hands. The present patentee adds a grooved roller, which is to be fixed in a suitable frame; the clothes, &c. to be washed, are laid upon the grooved board, where they may be kept moistened with soap-suds, and the grooved roller is passed backward and forward over them, the frame in which it revolves being held in, and guided by, the hand; there are, also, grooved guides on the frame, which work on projecting strips on the edge of the wash-board, to retain the roller and frame in their places.

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3. *A Fire and water proof cement;* James Coburn, Middlesex county, Mass. Sept. 3.

This is one of those specifications which, for the interest of the patentee, we have concluded not to publish.

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4. *A Socket vice;* Luther Hemminway, Sullivan, Cheshire county, New Hampshire, Sept. 4.

(See the specification.)

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5. An improvement in the *Machine for washing cloths;* Joseph Hathaway and Rufus Hathaway: the former of Pultney, Steuben county; the latter of Canandaigua, Ontario county, New York, September 5.

This machine consists of two hollow cylinders. The outside cylinder is fixed in a suitable frame, its axis being horizontal. This cylinder is made water-tight, and is divided into two parts, the lower half forming a trough, and the upper half a cover or lid. Within this cylinder, another is made to revolve, by means of a crank and gudgeons. The circumference of the inner cylinder, is formed by slats, dove-tailed into the circular ends, and standing about three-quarters of an inch apart. Into this, the cloth to be washed is put, there being a door for that purpose. The slats are sloped on the sides in reversed directions, so that when the inner cylinder is turned either way by the crank, the water shall have a tendency to flow from the outer into the inner cylinder. The motion proposed to be given, is a vibratory one, by turning the crank each way, about half a revolution. On two opposite slats, pins are placed, pointing towards the centre of the cylinder; these are intended to change the position of the cloth to be washed. The frame is to be kept together, and tightened, by iron rods with heads, screws, and nuts.

This machine, in its general features, bears a strong resemblance to others which have been heretofore used; the patentees say, "what we claim as new, and as our own invention, in the above described machine, is the operation of the open cylinder, and the manner of

fixing in those slanting slats, to carry the water to every part of the machine, to serve as drenchers; also the iron rods that fasten the frame together."

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6. An improvement in the *Mill for grinding corn*, or other grain; Reuben Medley, Bloomfield, Nelson county, Kentucky, September 5.

The main object of this invention appears to be the turning of both mill stones in opposite directions; as this is not new, the claim of the patentee must rest upon the manner of effecting this object. A vertical wheel, with cogs upon its face, works into two vertical trundles at its upper and lower points, and, of course, turns them in opposite directions. These trundles are attached to the spindles of the upper and lower stones, and the desired motion is thus attained. The manner of attaching the spindles, and hanging the stones, we do not think it necessary to describe. The patentee says, "what I claim as new, and as my invention, or discovery, in the above described grist mill, is the use, or application of the whole machine, with the exception of the two main wheels, and the wallower in the horse mill."

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7. An improvement in the *Mill for grinding and manufacturing all kinds of grain* into meal and flour; James Smith, and William Sapp, Mount Vernon, Knox county, Ohio, September 9.

(See specification.)

SPECIFICATIONS OF AMERICAN PATENTS.

Specification of a patent for a Socket Vice. Granted to LUTHER HEMMINWAY, *of Sullivan, Cheshire county, New Hampshire, September* 4, 1828.

THE socket vice may be made of any size, according to the use to which it is to be applied, and of metal or wood. When made to be used as a socket for awls, it should be of steel; its whole length should be about two inches and three-fourths; one end, for about three-fourths of an inch, should be round, and about one-fourth of an inch in diameter; beginning three-eighths of an inch from the end, it should taper slightly to the end, upon which, for the same distance, a screw should be cut; it should then diminish, and again increase in diameter, in both cases slightly, and gradually; at three-fourths of an inch from the end it is flattened abruptly, forming a shoulder on two sides, and is made tapering on the two edges, to the other end, where it is pointed; a hole is made longitudinally into the round end, about three-fourths of an inch deep; it is then cut twice transversely from the end to the bottom of the hole, dividing it into four equal parts; a hollow screw or nut, adapted to the vice, is screwed upon this end, compressing it so as to hold, firmly, the shank of the awl; the outside

shape of the nut should be square, so that it may, by means of a small wrench, be easily screwed on or off. The pointed end of the socket vice, may be inserted in a handle of wood, so far as to the commencement of the screw. When made for other uses, the size and the form of the shank may be varied, to suit such uses.

LUTHER HEMMINWAY.

Specification of a patent for an improvement in the Mill for grinding and manufacturing all kinds of grain into Meal and Flour. Granted to JAMES SMITH, *and* WILLIAM SAPP, *of Mount Vernon, Knox county, Ohio, Sept. 9th,* 1828.

THE following is a full and exact description of the construction and operation of the improvement made by us. A husk, together with a bray-board, bridge-tree, lighter iron and staff, are made after the usual manner, or on the plans laid down by the writers on mill-wright work, with the exceptions stated.

The bridge-tree may be raised or lowered by means of a screw and nut, or a screw and windlass, or, as in the usual manner, by a lighter strap and weight, at the discretion of the constructor. An iron spindle with a hardened steel foot is placed in an iron or steel step (as are already in constant use) and rises above the foot of the spindle (at the discretion of the constructor;) a whirl, pulley or trundle head (at the like discretion) is fastened on the spindle, by means of which the spindle is turned, by a strap, or by gearing, as in other mills in long and common use. Across the top of the husk, and parallel with the bridge-tree, are two pieces of timber, framed in for the purpose of supporting the works above; in the centre of the said two pieces of timber is another piece of timber framed in, and connecting the two principal pieces, in the form of the letter H. In the centre of the last named connecting piece of timber is a follower bush, through which the spindle extends. The bush is of two half circular pieces, which embrace the spindle and keep it steady. The bush is tightened to the spindle, at pleasure, by means of two wedges. This connecting piece, in the form of the letter H, referred to, should be about 8 inches square; in this connecting timber is a mortice about 16 inches in length, 4 in width, and 4 in depth. The spindle enters the centre of this mortice; at each extreme end is a notch across the timber, or connecting piece, the exact depth of the mortice, say on one side 6, the other 4 inches wide; the above named bush is placed in this mortice, the circular ends pointing to the centre, to hug the collar of the spindle; the wedges, above alluded to, are to be placed in the cross notches, and are intended to loosen or tighten the bush at pleasure; the face view of the mortice and notches, above alluded to, will appear as in the margin. The next part of the work, which occurs in ascending, is the platform made on the top of the husk and on the connecting timbers above named. Through

the centre of this platform is a circular hole, cut about, or near, one-third less in diameter than the stones to be used. Above the circular hole, and around, the stones should be surrounded with a hoop, in two pieces, of sufficient size to admit the running of the stone inside, and high enough to shut up the opening between the two platforms. The meal spout comes out from the inside of the hoop, after the usual manner. The lower stone is the running stone, and is called the runner; it has an even horizontal face, except the furrowing, such as is in other mills, and is secured to the top of the spindle in the following manner, to wit; by a driver with four wings, made of cast or wrought iron, having in its centre a square hole, larger at bottom than at the top; the top of the spindle is made to fit the hole, extending through; on the top of this spindle a screw is to be cut, the driver being placed in its situation, is screwed there, by a nut, fixed on this screw. Through the end of each wing of the driver is an iron screw, to work in its place in the driver; this is put in from the under side, and by the use of a wrench is to be turned to regulate the stone by raising or lowering either side, with the view to place and keep it on a perfect level on the driver. The bottom stone is fitted to receive the driver, by letting in. Two holes are in the driver, in the wings, at opposite sides; the indentations or cuts of the driver are large enough to admit the heads of screws of sizes suited to the size of the stones. The screws being inserted head-foremost in the stone, are secured there by pouring in melted lead or pewter, thus leaving the points outwards. The stone is placed on the driver; the points of said screws, through the said wings, in opposite situations, are secured by nuts, which effectually fasten the stone to the driver, which remains firm, and free from wabbling. The second platform is raised by a strong frame on the two pieces of timber before mentioned, the height of which must be regulated according to the thickness of the stones. This platform should be composed of one solid and thick piece of timber, fastened to said frame-work below, and extending up through said platform, with nuts at each end of said platform; at each end also is a screw through the said top, and their points rest on the frame, or block, of the upright of the platform. This gives the means of raising or lowering the platform with the upper, and stationary stone. This stationary stone should be let three inches into the piece of timber that forms the upper platform, and be wedged fast and further secured by means of screws fastened into the stones as described above, extending upwards through the platform, and then secured by nuts. The frame to support the hopper, together with the hopper, shoe, damsel, or feeder, are formed and situated as in other mills in common and long use, and at the pleasure of the constructor. The damsel or feeding rod, extends through the centre of the said second platform, and stationary stone, and through a hole about one and three-quarters of an inch in diameter, and is fastened at the foot in the centre of the runner, by making a small hole, say one inch in diameter, and three inches deep, filled with firm and strong wood: a piece of hardened steel, square, but small at each end, and

much larger in the middle, is to be entered about one-half, in the last named wood, the other end to enter the foot of the damsel, or driver, which must exactly fit. Immediately below the shoe, and in the upper part of the hole through the platform, through which the damsel or feeder rod extends, is placed a tin or other funnel for receiving the grain from the shoe, and guiding it to the aperture through the platform, and upper stone.

The feeding is regulated as in other mills. This plan is intended to include all sizes of stones; but a size not less than 16 inches, nor to exceed two feet three inches diameter, is recommended; and a motion ought to be given of four hundred revolutions per minute. This mill is designed and suited to any kind of power, the same as any other mill in common use. The bolt and elevators are to be put in operation in the same manner as in other mills.

What we claim as new and not in common use, and as our own discovery, in the above improvement and manufactory for grinding, and for the use of which we ask an exclusive privilege, is, that part of this mill which secures the following bush, and tightens or loosens it at pleasure; the manner of surrounding the stone by the hoop; the driver and its fixtures to carry and give steadiness to, and to level the runner; the securing and confining the runner and driver together; the manner of fixing the upper platform which receives and holds the stationary stone; the screws to raise or let down the said upper platform, and with it the stationary stone, and confine it to its proper and exact position; the fixtures of the damsel in the runner; and the use of the funnel for the purpose above specified. All of which last named specifications we claim to be new, useful, and our own invention: all other parts mentioned in the foregoing specifications have long been in common use.

JAMES SMITH.
WILLIAM SAPP.

Specification of a patent for a machine for planting of different seeds. Granted to AUSTIN H. ROBBINS, *and* LEVI ROBBINS, *Junr. of Denmark, Lewis county, New-York, August 13th,* 1828.

THIS machine, for which we claim a patent, and which performs the operation of planting, is placed upon a frame and wheel, similar in construction to that of a wheel-barrow. The length of the barrow frame is five feet, including the handles, and sixteen inches in width; and the wheel twenty-one inches in diameter. The axle of the wheel is like that of a common wheel-barrow, save near the wheel, there is a whirl turned on the axle, of different diameters, for the purpose of regulating the movements of the machine; and around which, a cord or a strap passes. There are two cross pieces, connecting the handles or arms; the first is thirteen inches, the second twenty-nine, from the centre of the axletree. From the centre of the second

cross piece, to the centre of the under side of the first, a piece, or perch, of wood, in a square form, passes, giving an inclined pitch of about five inches forward, to the same. This perch is secured to the cross pieces, at each end, by a bolt, screw, and nut; from this perch, two standards or posts arise, seven inches in height; on the first, immediately under a cross piece, hereafter described, is placed a shieve or pulley block, of different diameters, against which the cord or strap passes, in order that it should not chafe against the wheel, and to give ease to the motions of the other parts of the machine; the standards are united at the top by a cross piece, under which cross piece are two short knobs pressing upon the parts or boxes underneath; under this cross piece, and resting upon a short post or standard, which beneath rests on the perch, and also on the perch itself, is placed the improvement or invention claimed. The first thing to be noticed is, a circular box of the capacity of a half-gallon, more or less, resting in part upon the short post or standard, on the perch before described, and on another circular box placed directly on the perch below. The first box is perforated at top for the admission of a funnel, through which the seed is deposited in this box; and there is a circular plate of tin near it, capable of being turned, to close the aperture, when the funnel is removed. This box can be made of wood, tin, or sheet iron, or parts of either. There is a communication between, this box, and the one directly beneath, by means of a square orifice, at the inclined end of the box, guarded by a lip made of tin, to prevent the too free admission of seed, from the upper to the lower box. The lower box is five or six inches in diameter, and two and three-quarters deep. In this box is a circular plate, of wood or iron, to fit exactly in the box. The thickness of the plate, together with the diameter of the holes, regulates the quantity or number of seeds to be planted at one time. This circular plate is perforated with holes equi-distant from each other, and equi-distant from the circumference. This circular plate revolves round a spindle of sufficient length, to reach through the perch, the two boxes above, and the shieve, and about a quarter of an inch above the shieve, where it enters the cross piece, leading from the two upright posts, before described. On this spindle, immediately above the upper surface of the bottom of the lower box, is a shoulder, whereon the circular plate before described rests, and performs its revolutions. This spindle can be made either of wood or iron, the diameter about a quarter of an inch, and to correspond with the hollow of the cylinder, through which it passes. The passage of this cylinder through the upper box, or the orifice, through which it passes, is sheathed with tin. There is in the bottom of the lower box, an orifice directly over a hollow shaft, attached to the perch; the shaft is twenty inches in length. This shaft, at the bottom, penetrates the earth, and is sheathed with iron or steel in an angular form, the apex of the angle being towards the wheel; it may penetrate the earth to any required depth, and is open at the back and bottom, about three-quarters of an inch wide, through this the seed passes, and is deposited in the earth. This shaft is sup-

ported below by a brace, secured to the second cross piece by a bolt, screw, and nut, passing through the perch, cross piece, and brace. A cord or strap being placed on a whirl of different diameters, on the axletree, and passing from thence round the shieve or pulley block, laying flat upon the outer surface of the upper box, by pushing and moving the barrow forward, the revolution of the wheel and axle gives motion to the shieve or pulley block; and that, by being connected by means of a hollow perpendicular cylinder to the plate in the lower box, causes a circular horizontal motion to be given to the said plate, perforated as before described. These holes of consequence pass over the aperture of the lower box. The seed passes from the upper box, through the aperture, guided by the tin lip, before described, falls into the lower box upon the inclined side, and upon the circular revolving plate; and as often as the holes of the circular plate pass over the aperture of the lower box, the seed goes from thence into the hollow shaft, and is operated upon by a spring attached to the lower surface of the upper box, in order that no interruption may occur in the passage of the seed from the box, to the depository in the earth.

What we claim as new, and as our own invention or discovery in the above described machine, and for the use of which we ask an exclusive privilege, is, the whole machine above described, excepting the invention of the wheel-barrow. But we also claim the application of the wheel-barrow as our invention, to the use of the said machine. In witness whereof, we have hereunto subscribed our names the 1st day of August, in the year 1828.

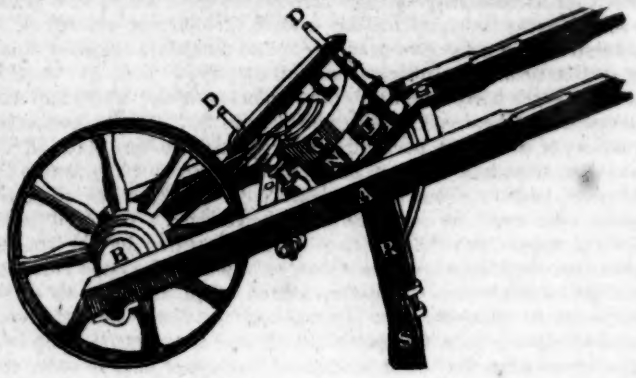
AUSTIN H. ROBBINS.
LEVI ROBBINS, Jr.

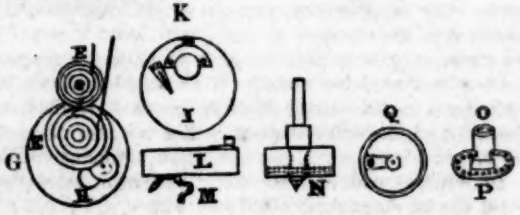
Remarks by the Editor.—The foregoing machine has been for some time in operation, and has been found to answer the intended purpose in the most perfect manner. An inteiligent gentleman who resides in the neighbourhood of the patentees, writes thus; "there can be no difficulty in the application of this machine to the planting any kind of seeds, and any number of them at a time, and at any required distance, as fast as a man can walk. When the rows are set four feet apart one way, and eighteen inches the other, there is no difficulty, nor is it a very hard day's work for a man to plant ten acres, after the ground is properly prepared to receive the seeds."

To the cotton planter, this machine will, we are persuaded, be particularly beneficial, not only as regards the saving of time, but also in the perfect regularity with which the rows may be planted. In applying it to this use, it will, probably, require some modification of the spring, on account of the fibres which remain upon the seeds; this, we are convinced, can be made without any difficulty.

On the next page are the drawings and references, attached to the specification.

A. H. AND L. ROBBINS' PLANTING MACHINE.





A, the frame.
B, the whirl on the wheel.
C, the inclined perch.
D D, standards or posts.
E E, shieves or pullies.
F, short post or support.
G, the upper box, into which the seed is put.
H, opening in the top of the upper box.
I, lower side of box G.
K, square orifice with its guard of tin.
L, side view of the upper box.
M, a spring, which forces out the seed to be sown.
N, lower box.
O, hollow cylinder attached to P, the lower plate.
Q, lower side of lower box.
R, hollow shaft through which the seed passes into the ground.
S, sheathing of iron, or steel.

Specification of a patent for a Machine for Planting Grain and other Seeds. Granted to ORSON STARR, *of Richmond, Ontario county, New York, August* 22, 1828.

A BOX, or hopper, of a suitable size, is provided for holding the seed to be planted. This is to be firmly fixed upon a carriage, or bench, framed together for that purpose. This carriage has handles like the common plough, and is furnished, on the fore part, with an

iron, which is formed like the shovel of the common shovel-plough, for the purpose of forming the furrow or drill, into which the seed is to be dropped. The carriage runs upon two wheels, which are firmly fixed upon an axle which turns with the wheels, being furnished for that purpose with collars, or boxes on each side of the carriage; this axle crosses the carriage immediately under the box, or hopper. Upon the middle of the axis, a third wheel is fixed, but of less diameter than those upon which the carriage runs. The bottom of the box, or hopper, has a slot, or opening, through it, to admit the middle wheel to pass through, so that in revolving, the upper part of the rim will be within the box containing the seed to be sown. This wheel is usually made of sheet iron, and is in the form a cylindrical drum; the edge of it is perforated at suitable distances, to receive pieces of metal, which act as valves, working upon a pin, and forced out by springs contained within the wheel, so as to project beyond its periphery, but capable of being forced in, and to be flush with the rim, when passing the ends of the slot, in the bottom of the box. These valves are excavated so as to contain the quantity of seed required, and may be more or less numerous, according to the distance at which they are to be dropped in the furrow.

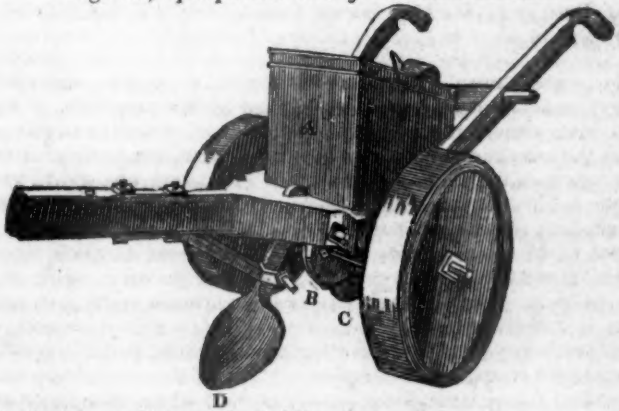
Behind the seed wheel there is an iron scraper, fixed to the frame of the carriage, of a proper form for closing the earth over the furrow in which the seed has been planted.

The whole machine may be varied in its form and dimensions, as well as in the materials of which it is composed; but what I particularly claim as my invention, or improvement, is the centre wheel, with its valves working in the manner above described and specified.

ORSON STARR.

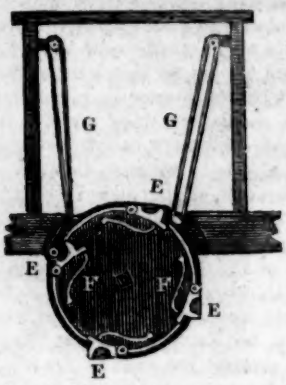
ORSON STARR'S MACHINE FOR PLANTING GRAIN, &c.

Fig. 1st, a perspective view of the whole machine.



A, the box, or hopper, for holding the seed.
B, the centre, or planting wheel.
C, the scraper to close the earth upon the seed.
D, the shovel.

Fig. 2 a section of the box and planting wheel.



E, E, E, E, the valves hollowed to receive and drop the seeds.
F, F, springs to force the valves out.
G, G, leather straps passing round slots or cleets, and against which the valves work.

Specification of a patent for an improvement in the mode of propelling Vessels upon the water, and carriages upon the land, by the combined action of Steam and the pressure of the Atmosphere, without the use of Paddle Wheels. Granted, in pursuance of a special act of congress, passed May 24, 1828, to* EDWARD ALLEN TALBOT, *of Dublin, in the kingdom of Ireland, but now residing in the United States. Patent issued, June 21, 1828.

IT is well known, at least to the scientific engineer, that by the use of paddle wheels, ordinarily applied to the propelling of boats and other vessels, there is very great waste of power, arising in part from the construction of the wheels themselves, but principally from the nature of the fluid upon which they have to operate, which, owing to the facility of displacing it, renders it necessary, in order to attain a sufficient resistance for the purpose of propelling large vessels, to resort to the use of paddle wheels of a very great diameter, varying from 16 to 24 feet. The great, although not the only object, of my invention is, therefore, to obviate these disadvantages, by the application of a resisting power, which shall operate within the vessel, and thus preclude the necessity of using paddle wheels, floats, or any other instrument or apparatus intended to act upon the surrounding water. To effect this purpose, I use (in the absence of any cheaper or more efficient power) a steam engine of any description, giving, however, a preference to the Boulton and Watt's low pressure engine. I shall, therefore, confine myself, in this specification, to the action of

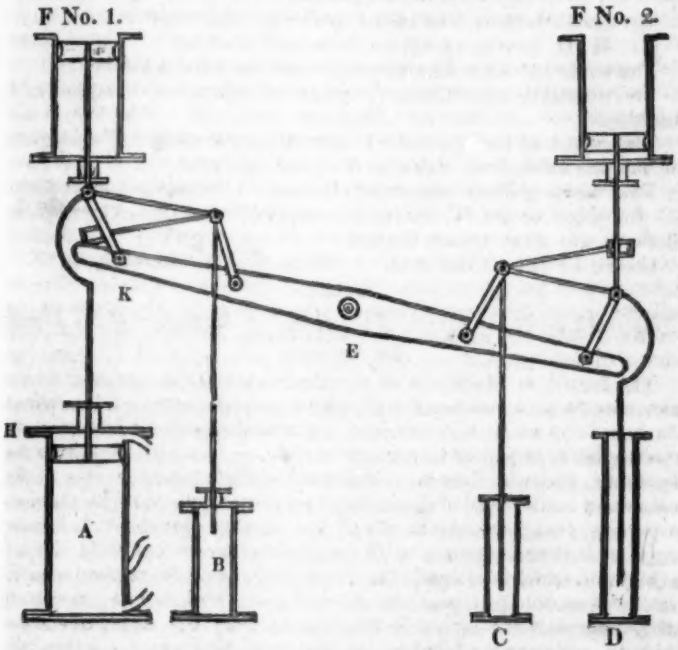
this engine. In the annexed drawing, A is the steam cylinder, B the air pump, C the hot water pump, D the cold water pump, E the beam and parallel motions, F, F the atmospheric cylinders. The whole of this machinery is placed horizontally, the atmospheric cylinders having their open ends towards the stern of the vessel intended to be propelled. The working beam is attached to the piston rods by segments or parallel motions. The piston rods of the atmospheric cylinder, F No. 1, and the steam cylinder A, are connected together, and the axes of the cylinders being in the same horizontal line, their pistons move simultaneously;—I have not been particular in representing the valves, steam boxes, steam pipes, and other appendages for the induction and eduction of steam and other purposes, as they may be constructed and placed in various ways, according to the fancy or the judgment of the engineer. I have merely drawn the pumps, to show how they and the valves may be worked by the beam E. I do not assign any particular dimensions to my cylinders, or to the other parts of the engine, as these must vary according to the power required; nor do I give the relative proportions of the steam and atmospheric cylinders, as those also will depend upon the velocity with which it may be deemed adviseable to work the steam piston. But for the purpose of explaining the action of this invention, I will assume certain arbitrary dimensions, and exhibit in numbers, what I conceive will approximate sufficiently near to the truth, to render manifest the great superiority of this mode of propelling vessels, to all other methods heretofore practised. Suppose a vacuum to be effected behind the pistons of the atmospheric cylinders, the whole weight of the atmosphere will press upon their faces, and allowing the pistons to be 40 inches in diameter, this pressure will amount to about 17,600 pounds upon each piston; hence the fulcrum of the beam, E, will be pressed in the direction of the bow of the boat, with a power of 35,000 pounds, whilst the cylinders will be pressed in the opposite direction by the same power. Thus far the boat will be no more affected by the creation of the vacuum, than if it did not at all exist. Taking it then for granted, that it will require, in addition to the pressure of the atmosphere upon F No. 1, an application of steam in the cylinder A, capable of exerting a force of 1000 pounds (above what is necessary to overcome the friction) to force out the atmospheric piston F No. 2, with a velocity of 80 feet per minute, it will obviously require a steam power of 19,600 pressing upon the same side of the steam piston, to force out the same atmospheric piston with a velocity of 160 feet per minute. Then, if the steam cylinder be 48 inches in diameter, the area of whose piston would be 1810 2-7 inches, and supposing the vacuum perfect, and the pressure of the atmosphere to be equal to 14 pounds upon every square inch, and the steam gauge to stand at 6 inches, there would then be a pressure of 17 pounds per square inch upon the piston and 17 × 1810 2-7 = 30.774 6-7. Now if we deduct one-third of this as an allowance for friction and working the pumps, a disposable force of considerably more than 19,600 pounds will remain; and this, divided into horse power according to the estimate of Boulton and

Watt, will be found equivalent to the work of 142 horses; or, in other words, the boat will be propelled by a constant force of 19,600 pounds, as may be proved by the following calculation. The pressure of the atmosphere upon the close ends of the atmospheric cylinders, the diameter of whose pistons is assumed to be 40 inches, amounts to 17,600 pounds upon each; consequently, the boat is pressed in the direction of the stern, by a power of 35,200 pounds. As the steam cylinder is close at both ends, it is not affected by the pressure of the atmosphere, or rather it is kept in equilibrio by its equal action on both ends. Now, when the steam enters into that end of the steam cylinder marked H, it will press the cylinder towards the stern with a power of 30,774 6-7 pounds, making in the whole, a pressure of steam and atmospheric air equal to 65,974 6-7 pounds, the tendency of which would be, were there no reacting power, to drive the boat stern-ways. But as the end of the beam marked K, is pressed towards the bow by the united influence of the weight of the atmosphere upon the piston F No. 1, and the force of the steam upon the steam piston, making together a power of 48,374 6-7 pounds, the entire of which is required to overcome the friction, and force out the atmospheric piston F No. 2, with a velocity of 160 feet per minute, the fulcrum of the beam will be pressed in the direction of the bow, with a power of 96,749 5-7 pounds, from which deduct 65,974 6-7 pounds, and there will remain, forcing the boat ahead during the first stroke of the piston, 30,774 6-7 pounds, minus the friction. Now, during the completion of the second stroke, the atmospheric cylinders will, as before, be pressed towards the stern by a power of 35,200 pounds, whilst the steam cylinder will now be pressed in the direction of the bow, with a power of 30,774 6-7 pounds, and the fulcrum of the beam, with the full pressure of both the atmospheric pistons; leaving, as before, a balance of power to propel the boat ahead, amounting to 30,774 6-7 pounds, minus the friction. Now, deducting one-third of this for friction, the boat will be continually under the influence of a propelling power, exerted to drive her ahead, of upwards of 20,000 pounds, a force equal to that which would be exerted by a 1400 horse power engine, driving paddle wheels 24 feet in diameter, and whose piston should travel at the same velocity that I assign to mine, namely 160 feet per minute, and whose consumption of fuel and steam would, consequently, be nearly, if not entirely, in the proportion of ten to one of mine. It will be evident, to every practical engineer, that power of any kind may be applied to this invention, and that it will be found equally adapted to the propelling of carriages upon land, as to vessels in the water. It is not, therefore, any monopoly in the use of the steam engine separate from this invention, that I seek. *It is the application of the pressure of the atmosphere as a resisting medium*, through the instrumentality of which I can, by the aid of a steam engine connected with my atmospheric cylinders in the manner here described, propel vessels or carriages of any description, without, as it regards the former, allowing any part of the machinery to act upon the water as a resisting medium, or as it respects the latter, being obliged to re-

sort to the use of wheels, cranks, or other contrivances intended to operate upon their wheels or axles.

EDWARD ALLEN TALBOT.

E. A. TALBOT'S PROPELLING ENGINE.



Remarks by the Editor.—Agreeably to the promise made in the August number of this Journal, we have given the specification of Mr. Talbot's engine, with the requisite drawing. The patentee is evidently a gentleman of much intelligence and science, and, of course, has the fullest confidence in the correctness of the principles upon which his machine is intended to act. Several gentlemen in Washington, who, deservedly, rank high in the scientific world, have entertained opinions respecting it, sufficiently favourable, to cause an experiment to be made; we were not present, and of the result we are not particularly informed; we understand, however, that the patentee is about to try the thing on a large scale.

We have endeavoured to discover in the arrangement proposed, some efficient power to propel a boat or carriage, but, although the inquiry has been instituted, with an unfeigned deference to the opinions of some of the gentlemen above referred to, it has been in vain. We are still entirely in the dark, and ready to submit, patiently, to the imputation of stupidity, whenever, by means of this apparatus, a boat shall have been made to travel a mile, in still water.

Franklin Institute.

The nineteenth quarterly meeting of the Franklin Institute, was held at their Hall, on the 16th Oct. 1828.

Mr. Isaiah Lukins, was called to the the chair, and
Mr. M. D. Lewis, appointed Secretary, *Pro tem.*

The minutes, of the last meeting were read and approved.

The quarterly report from the Board of managers, was read and accepted.

The report of the Premium Committee, to the board of managers, on the late exhibition, was also read and approved.

The meeting then proceeded to elect a Recording Secretary, in the place of Dr. T. P. Jones, resigned, when Mr. Algernon S. Roberts was unanimously elected.

Isaiah Lukens, *Chairman.* M. D. Lewis, *Secretary, P. T.*

Nineteenth quarterly report of the Board of Managers of the Franklin Institute.

The Board of Managers of the Franklin Institute, present to the members the nineteenth quarterly report, containing their transactions during the term which has elapsed, since the last general meeting. In this period events have transpired interesting in a high degree to the Institute, and which seem calculated to diffuse a proper idea of the value and importance of the institution, not only in our own community, but among the mechanics of the country generally. Among these the Board mention with peculiar pleasure the fifth annual exhibition, which was opened on the eighth day of the present month, at the Masonic Hall, and closed on the eleventh. The committee of premiums, have obtained the reports from the respective committees appointed as judges of the particular articles exhibited, an abstract of which is presented in their general report, which also contains the award of the premiums, in conformity with the conditions published.

There appears to exist now but one opinion of the value and utility of these exhibitions, not only as a means of exciting the emulation of Artisans and Mechanics, and consequently of producing a superiority in the workmanship and quality of the articles exhibited, but as serving also to diffuse a correct knowledge of the present state of American manufactures. Although in the late exhibition, manufacturers of goods of several kinds, neglected or failed to supply specimens of the productions of their establishments, there were many articles which were new, and a striking evidence was afforded of considerable improvement in quality and finish, in the kinds heretofore furnished. The regulations of last year were adopted, and it was universally acknowledged, that the small charge for admission, contributed to promote the comfort and convenience of the visiters. Although members were admitted with two ladies gratis, there was received for tickets, at the rate of twelve and a half cents each, the sum of seven hundred and fifteen dollars.

The board have witnessed with great satisfaction, the attention of those gentlemen who were appointed as managers of the exhibition. In the execution of their duty, a very considerable portion of their time was consumed both before and during the exhibition; the neatness and order of the arrangement of the different articles exhibited, fully proved how faithfully they executed the trust committed to them.

The necessary arrangements have been made for the opening of the drawing school, and for the delivery of some of the lectures for the ensuing season. Mr. Hugh Bridport, will continue his superintendence of the former department, assisted by Mr. George Strickland, who is advantageously known to the public, for his skill in architectural drawing. The board regret that the drawing school has not been patronized, in a manner, such as its manifest utility and the talents of its instructers would seem to demand.

In consequence of the vacancy in the professorship of mechanics and natural philosophy, not being yet supplied, the requisite arrangements for the delivery of that course, have not been made. A special committee has been appointed on this subject, and the board have no doubt of obtaining the services of a person qualified to deliver lectures on these subjects.

Dr. Bache will deliver a course of chemistry, as applied to the arts, to commence early in November.

The board is desirous that a course of lectures on mineralogy, and geology, should also be delivered, and are endeavouring to procure the services of some competent person.

Saturday evenings will be reserved for volunteer lectures.

The board have referred the subject of a system of text books for the younger part of the audience in attendance upon the lectures, to the committee of instruction and the professors, and hope the most beneficial results from their introduction. All which is respectfully submitted, on behalf of the board of managers, by

Samuel W. Robbins, *Chairman.*

On the Combination of a Practical with a Liberal course of Education. By W. R. Johnson, *Principal of the High School of the Franklin Institute.*

No. V.

The duties of the several classes of persons employed to give instruction, or to maintain discipline, under the High School system, next require attention. It may not be improper to observe in passing, that the term *system*, as here used, is applied to the whole combination of means by which the intellectual, moral, and physical improvement of youth in schools, is to be effected. This remark is the more necessary, on account of the confusion which an erroneous application of the term has often produced in the conversations and writings

of those who have undertaken to discuss the subject of education. They sometimes call that a *system*, which is, in fact, only a *method*, and approve or condemn the former on account of some real or imaginary defects in the latter. A system necessarily embraces several methods, and requires several persons to execute it. The methods of teaching may, therefore, sometimes be good, while the system into which they are incorporated, is in other respects essentially defective; or the general system may be good, and yet contain some methods at variance with its spirit and character. A method may often be executed by one who possesses little power of combination, and who would be wholly unfit to direct a system. As a method bears to a system the relation of a part to a whole, so it is in turn divisible into parts or *sub-methods*, some more, and some less difficult of execution, some demanding little maturity of judgment, and others requiring the utmost skill, discernment, and strength of character to ensure their success.

This difference in the degrees of difficulty in the several duties of instruction, is the foundation of the peculiar arrangement and distribution which, under the High School system, is made of the offices of *teachers, tutors, and monitors.* By that distribution, all the more easy and mechanical parts of teaching, all those parts which, from their very facility, and from their "constant, stale, and tasteless repetition," become burthensome to the adult teacher, are performed with alacrity by tutors or monitors, for whom they still wear the charm of novelty, and to whom they afford excellent opportunities for increasing their expertness, or evincing their previous attainments. At the same time the powers and energies of the master, are brought to act wherever the nature of the subject requires much elucidation, and wherever taste and judgment are more concerned than memory, alertness, and dexterity. The irksomeness of teaching, is thus greatly diminished, and still, by means of frequent examinations and daily reports respecting the state of preparation, the responsibility of the pupil is fully sustained. The number of teachers employed in the institution, is seven, of whom one instructs in the ancient languages and the English branches; one in each of the modern languages, French, Spanish, and German, and one in drawing; one has the charge of the preparatory school, and another teaches penmanship, in the same department. Additional teachers are employed, when the number of scholars, or of branches to be taught, demands increased assistance.

The duties of teachers consist in instructing the tutors and monitors in their respective branches, and all the other members of their classes in those parts of the subject which require a master's talents; in superintending classes while reciting to monitors; preserving order; prescribing the methods to be pursued; minutely inspecting the operations of the several divisions to which they pass in succession; and in hearing appeals from the decisions of monitors, when made in conformity to the rules of the class. They also examine scholars in those parts of their studies which have been pursued under monitors, and give credit to the latter, according to the manner in which they

have executed their trust. Each master keeps a journal, in which he enters all credits and discredits of the monitors and pupils under his direction, specifying what number of exercises has been well performed, how many have been neglected, and how many imperfectly prepared. Many of these notes are taken from lists kept by the monitors, while others are the result of the teacher's own personal observation. The whole are, at the end of each half quarter, transferred to the register, to become the basis of a new classification, and to remain as permanent memorials of the scholar's character, at all times subject to the inspection of parents and others, who are interested in its contents.

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*Offer of a new and improved Plan of constructing Iron Rail-ways and carriages, by which all sorts of goods, merchandise and other articles whatever, as likewise Passengers, will be conveyed with much greater ease, convenience, and speed, and with less expense than could till now be effected, by employing either the power of Steam or that of Horses.**

It is generally acknowledged by the most eminent engineers and by the most impartial writers on mechanical subjects, that the present construction of rail-ways, and of the carriages or wagons conveyed upon them, is still very far from being arrived at that degree of perfection of which, by their principle, they appear to be susceptible, and it cannot be denied that, upon the whole, this most valuable invention is yet in a state of infancy.

To this imperfect state it is undoubtedly owing that those artificial roads, though known, and partially used, for a century past, have, till now, not been extended to a more general application over whole countries, and for all sorts of conveyance; that the greatest part of those companies which a few years ago had associated themselves for the establishment of rail-ways in different directions all over England, have been dissolved, and that almost none of those numerous and magnificent projects which were announced in the English papers, has been carried into execution.

It is, therefore, my opinion, that, before any important and extensive plan of that kind can be adopted with a certain prospect of suc-

* A printed copy of this interesting article has been communicated to us by a very distinguished individual, who received it from the Chevalier De Baader. The details of the plan have not been made known, nor will they be, until measures have been adopted to secure to the inventor a fair compensation for his improvements. As but a single copy of the printed "offer" has been received, we have thought that its insertion in the Journal, would be likely to call public attention to the subject, and, probably, promote the views of M. De Baader. The paper was printed at Munich, in the English language, and, as the intentions of the writer are sufficiently clear, it has been thought best to copy it verbatim. EDITOR.

cess, it will be necessary to bring those roads, with their vehicles, and all their other mechanical contrivances, to a higher degree of perfection, by removing all the difficulties and inconveniences to which, in their present state, they are subject.

In the first place, on the flat rails, or tram-ways, as well as on the edge-rails, the continual rubbing of the wheels against the upstanding rims of the plates, or of the projecting flanches of the wheels against the sides of the rails, causes a considerable resistance, by which not only a great part of the moving power is wasted in a useless manner, but which also tends to loosen the rails, and disturb their foundation. This is particularly visible on all sorts of rail-ways where the carriages are drawn by horses, who, by their trampling, shake the sleepers, and the whole foundation, in such a manner, that the rails become in a short time loose, with their joints displaced, their ends standing up, and their parallelism destroyed; the immediate consequences of which, are, an increased resistance, violent jolts, frequent breakings of wheels and rails, continual repairs and delays, and the speedy destruction of the whole work.

2ndly. Where horses are employed, the flat as well as the edge-rails, but particularly the first, are continually filled, and covered, with sand, gravel, or mud, thrown up by the feet of those animals, so that the rails often become so obstructed as to occasion a considerable resistance to the carriages passing on them.

3dly. With regard to the wagons, or carriages, used upon either of these rail-ways, their present construction is so clumsy and defective in every respect, that they hardly deserve the name of *Machines*. As both axle-trees are immoveably fixed on the body of the wagon, or tram, these vehicles can only go forward and backward in a straight line, and the least deviation from that line occasions a very considerable rubbing and fretting of the wheels on the bottom, and against the sides, or rims, of the rails, and, of course, a great additional resistance, with a most destructive wear and tear of the rails and wheels.

4th. On such places where a rail-way ceases, or where it must be interrupted, which is unavoidable upon long lines passing through towns, over long and narrow bridges, etc., these wagons are incapable to leave the rails, and to be brought over any common road, paved street, or other ground. They must, therefore, be unloaded, and their contents carried on, upon common carriages—a very troublesome operation, which is always attended with expense and great loss of time.

5th. One of the greatest objections to the present system of rail-ways, is, that the carriages are so confined to the track of the rails that they cannot, like common carriages upon a turnpike-road, turn out to pass each other when meeting upon the same line, or where a slower moving train is overtaken by a quicker one. The siding places, or turn-outs, employed for that purpose in England, are but a very imperfect and bungling contrivance. They can only be placed at certain distances, and are of no use to the carriages meeting between those places. Their management is extremely tedious and

troublesome, and though, for want of a better and more convenient method, they may answer in some degree for the slowest transports, they will be of no service at all for quick conveyances, on account of the great loss of time attending every such operation, and of the danger of the carriages running foul of each other, because the *momentum inertiae* of such masses cannot be stopped so quickly and easily upon a rail-way, as upon a common turnpike-road.

6th. As the principal advantage of rail-ways, and their great superiority over canals, consists in the quickness of conveyance, and in the possibility of employing mechanical power instead of horses, the application of locomotive and stationary steam-engines, has been proposed, and partly introduced in England, for the propelling of all sorts of vehicles upon iron rail-ways. But of all the trials which till now have been made, not one has yet succeeded to such a degree as to answer fully the sanguine expectations of their projectors. The greatest speed which, with either of these engines, can be given to a train of heavy loaded carriages, without the most imminent danger of dashing both rails and wagons to pieces, does hardly exceed six miles an hour; and as the greatest part of the power of the locomotive engines is absorbed by their own weight, and of the stationary engines by the weight and friction of the long ropes or chains, the expense of fuel is very considerable, and surpasses the expense of horses wherever a ton of coals costs more than 8 shillings.

Being perfectly acquainted with all the newest mechanical inventions, by a stay of nine years in England, and strongly impressed with the high importance of this particular subject, I have for these twenty years past applied myself with the greatest assiduity to the improvement of rail-ways, and by constant study, and after many expensive experiments, I have at last succeeded in hitting upon an entirely new plan, by which all the difficulties and inconveniences here enumerated are completely removed, and the conveyance upon rail-ways is brought to a degree of perfection which, till now, was scarcely thought possible.

The principal advantages of this new plan are as follows.

The rails are constructed in such a manner that the carriages move along them with the greatest facility, and without any sensible lateral friction, though the wheels are regularly kept upon their track. By this means, and by a more advantageous, yet simple, construction of the wagons, the resistance is so much reduced, that upon a dead level the power of one horse is sufficient to draw, with ease, and in a good pace, a load of 12 to 14 tons upon several carriages linked together.

The foundation of the rails is fixed in a much more solid manner; and, as the horses do not walk between the rails, but on the outside of them, and upon a separate path, which is somewhat lower, their trampling cannot injure the foundation, nor can they throw any sand or mire upon the rails, which, of course, will never be obstructed.

The peculiar construction of the carriages allows them not only to turn without the least difficulty in any deviating direction, and upon a curved rail-way of the shortest radius, (f. i. of 20 feet,) but also

to leave the rails, and to be conveyed over common roads like any ordinary wagon. These carriages, therefore, can go on without interruption, through towns and villages, and over bridges, where the rails cannot be continued, remaining loaded till they arrive at their final destination.

By a very simple and easy contrivance, my carriages can also be turned off the rails, at any point where it will be found necessary, either to avoid other wagons meeting on the same track, or to pass by those which they have overtaken, and return again into their first line; so that no siding-places, turning plates, nor any other apparatus of that kind are necessary for such an operation, which can be performed almost as quickly and easily as upon a common turnpike-road.

This very important improvement affords the advantage, that a double track of rails will be sufficient for the most frequented traffick, or intercourse, for which, in the common way, five or six parallel tracks would be required; and that any number of slow and heavy wagons can pass on the same line, and at the same time, with as many light and quick carriages, in the same, or in an opposite direction.

To employ the power of steam with the greatest advantage, and with the least possible expense, for the propelling of all sorts of carriages upon rail-ways, I have discovered a new principle, by which the power and motion of stationary engines, established at considerable distances, or intervals, and working without interruption, can be imparted to any number of loaded carriages passing upon a rail-way, from one engine to the other, *without ropes, or chains, or any other intermediate apparatus*, and with any (reasonable) velocity.

A rail-road constructed any where upon this new plan, and with all these improvements and new inventions, the reality of which is partly proved by experiments made upon a pretty large scale, partly founded upon the most infallible principles, (and for the success of which I will make myself responsible) cannot fail to have a decided superiority over canals, as well as over common rail-ways of the present construction used in Great Britain.

This superiority has already been acknowledged by a committee of the Royal Academy of Sciences, and by one of the Agricultural and Polytechnical Societies at Munich, who, after having examined my plan, and assisted at the experiments, have made and published very favourable reports. And though there is in this country a strong interested party for canals, yet all our proprietors and capitalists, and also the majority of both houses of our representative assembly, are so well instructed and disposed, that my plan for uniting the two greatest navigable rivers in Germany, the Danube and the Rhine, (through the Mayn) by means of an iron rail-way of my invention, is about to be adopted.

But I am convinced that no where in the world the introduction of this new plan of rail-ways could afford such immense advantages as in the United States, where the most rapid and prodigious progress in every branch of internal improvement, industry

and commerce, protected by the wisdom of an enlightened and liberal government, and supported by the public spirit of an enterprising nation, are already the admiration of all Europe; and where, to arrive at the highest degree of national wealth and prosperity, nothing more is wanting, and nothing can be more desirable, than the greatest possible multiplication, and facilitation, of internal communications.

By adopting this plan, instead of the ordinary English system, the iron rail-way between Baltimore and the Ohio, the construction of which is already decided upon, might be established with much greater advantage and with a saving of nearly two millions of dollars.

It has lately been proposed to unite the Chesapeake-bay with the Ohio, by a canal between Georgetown and Pittsburg, and the expense of this canal is previously estimated at 22,575,426 dollars, of which sum nearly one-half will be required for the middle section alone, on account of the great number of locks, and a most expensive tunnel, by which this part of the canal is to be conducted over the highest point, below the summit of the Backbone mountain. As far as I am able to judge, by the report transmitted by a message from the president of the United States, and published at Washington, last year, it appears to me that a double track of iron rail-ways, with a sufficient number of stationary engines, executed in the most complete and solid manner, would answer the purpose infinitely better, and save about two-thirds of that sum, and as much of the time required for the conveyance of all articles from one point to the other. Light vehicles with passengers, and mails, might be transported upon this rail-way with the greatest safety and convenience, in 36 hours, by day and night. Besides, there would be the very important advantage, that the rail-way could be used the whole year, with very few interruptions; whereas the navigation upon canals, in that climate, is generally confined to eight months. If, however, my plan would be adopted only for the middle section, upon the length of 72½ miles, a saving of 7 to 8 millions might easily be made, and the traffic carried on with much greater expedition. But, as, in this case, the loading and unloading from the canal to the rail-way, and from the rail-way to the canal, would be rather troublesome, and attended with extraordinary delays and expenses, I should recommend the construction of a rail-road for the whole line between Georgetown and Pittsburg, *by which about 15 millions of dollars would be saved, the whole work finished in a much shorter time, the expense of entertaining and repairs greatly diminished, the transports rendered more expeditious and convenient, and the annual income to the proprietors and share-holders might be doubled, even with lowering the tolls.*

The Chevalier Joseph de Baader,

Knight of the order of merit of the Bavarian crown, Counsellor of mines, and Professor of practical Mechanics at the University of Munich, member of the Royal Bavarian Academy of Sciences and of the several foreign learned Societies, One of the Directors of the Board of Agriculture and of the Polytechnical Society at Munich.

Munich, the 19th March, 1828.

NOTICES.

American Manufactures.—The recent exhibition at the Franklin Institute, together with similar displays in other parts of the union, have more than justified the anticipations of the most ardent friends of this species of national industry.

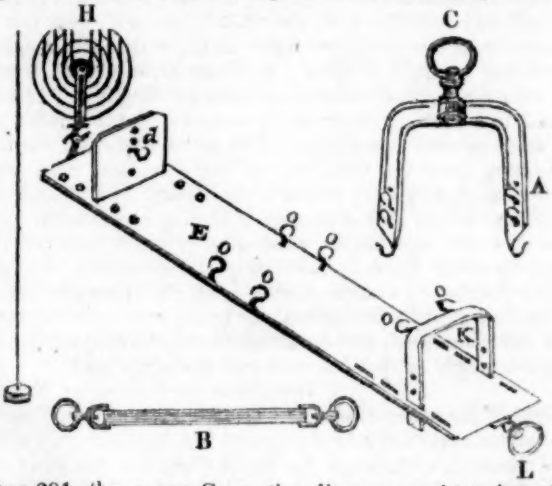
Nor has our progress been confined to manufactures of the first necessity; those which minister to our gratification as articles of luxury and of taste, have not lagged behind; the conjoined skill of the artist and of the artisan, decorates our persons and our dwellings, in a style which would be creditable to any country.

Whilst speaking on this subject, we acknowledge ourselves indebted to Messrs. C. Woodward & Co., whose card is inserted on the cover, for the gold tipped pen, with which we now write. The silver case, which contains the pen, and an ever-pointed pencil, is equally firm, neat, and elegant. There is an improvement in the socket, which is slit, this causes it to spring, and embrace the lead, and prevent its falling. We think it equal to the best imported.

ERRATA.

Owing to a mistake at the printing office, a part of the last number was put to press, without having been corrected by the Editor, and the errors are, in consequence, more numerous, than those of the whole preceding volumes, as special pains have been taken in this particular.

Nearly all the letters of reference on the cut of Casey's Dormant Balance, p. 269, were misplaced. We, therefore, insert it again, placing the letters so as to correspond with the description.



In page 281, the upper C on the diagram ought to have been a small italic letter (*c*).

Page 282, 18th line from top, for (E) *read* (D).

Page 283, in lines 11. 13. 15. for M, M, M, *read m, m, m.*

Page 284, 14th line from bottom, for Brighton, *read* Beighton.